SCIENCE TEACHING IN TRANSJORDAN

in the light of

PROGRESSIVE EDUCATION

A critical evaluation

BY
HASAN S. NABULSI

A thesis

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PREFACE

The importance of science teaching for the youth of Transjordan cannot be over-emphasized. It is not an exaggeration to state that the development of Transjordan into a modern state depends primarily on a sound scientific education of its youth.

The teaching of science should contribute to an adjustment of the individual in this rapidly changing scientific and industrial era. Science teaching must make for the liberation of the minds of our youth from dogmatism which checks and delays progress in all aspects of life.

Science like all other subjects in the program is taught in Transjordan in a manner which stresses verabal acquisition of facts. This study consists of a presentation and an analysis of prevailing practices in the teaching of science in the light of philosophical and educational principles. A tentative desigh for science education in Transjordan has been suggested.

I wish to express my gratitude and Thanks to the Chairman and members of the Department of Education in the American University of Beirut who red this these before it was typd and gave valuable observations and advice.

HASAN S. NABULSI

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Transjordan was educationally neglected during the Turkish regime. To be able to read a letter was a rare accomplishment. The present system prevailing now was first founded in the year 1922-23.

The aim of education is said to be the production of an arab nationalist who lives as other civilized men do. This aim is neither clear nor definite. What is a civilised man? Is he the one who uses scientific knowledge and controls forces of nature? Is he the one who exploits others both in and out of his national boundaries. Or, is he the one who is skilled in war?

The importance of science is obvious and needs no advocation. The whole rapid change in all phases of life is attributed to science in part or in whole. The application of science in medicine made for the preservation of the lives of individuals, thus increasing the population of the world. Its application in industry made for a counter balance to the increase in population by an increase in production. This was done through the substitution of machine labor for human labor. From the social point of view, ways of communication made it easy for more social intercourse. The aggregation of laborers in factories made for the foundation of labor unions which became influential. The political movement following this

social change was coloured with material socialism which lead lastly to the communization of nearly half the population of the world. The ideal of democracy spread rapidly. Women proved to be equal to men in factories. They also are entrusted with the education of children in their critical years of development. Thus they have the right from the two practical points of view-economic and educational. But educational equality of opportunity is the only way to attain policical equality of opportunity. Another thing is that the present situation is a challenge for education. Scientific power can be used for the welfare or destruction of humanity. Education must aim at fostering the attitudes necessary for understanidng and cooperation.

This intruduces us to the realm of philosophy in relation to education. Philosophy aims at resolving social conflicats. The cause of these social conflicts is discrimination of some kind. Science, Philosophy, education and social change affect one another. The sequence, according to Dewey, is from science to industry, to social change, to education to, philosophy. Industry changes social order; social order is reflected in education; education should have a guide to save it from routine and that guide is philosophy. But to what extent does this progression work? It did not work in the last two factors. Education still has its traditional spirit and methods. Ends did not change in the same speed means did. So we have a cultural lag.

The objectives of science teaching in Transjordan are preparatory for higher institutions of learning. The objectives of science teaching should center around:

1. Functional understanding of facts, concepts, and principles of science
2. Skills and the method of problem solving.
3. Attitudes, appreciations, and interests.

In Transjordan, the curriculum is laid down by a committee appointed by the Minister of Education. Inspectors are also members of those committees. Curriculum is taken initiatively. This situation should give way to a curriculum stemming from objectives of science teaching, rather than preparation to higher institutions, and needs of the individual and community.

Evaluation of the educative process, including results, is based on information. This makes for the neglection of the importance of education as a change in behavior so as the individual will be able to adjust himself later in novel situations. Instead, he is forced to acquire information in a passive way.

We see that the whole educative process is traditional and authoritative.

Life is a dynamic continuous process of adjustment aiming to meet the needs of the individual - biological, emotional and social. The biological need is to be met so as the individual maintains himself. Emotional security is necessary for his well being. The intellect plays its role in finding the best techniques to meet the needs of the individual. This does not mean that these needs are separable; on the contrary, the stability and well being of the individual depend on the harmonious interaction and satisfaction of all of them.

So, the curriculum should center around satisfaction of the needs of the individual in a social setting and harmony. The topics would be:

1. A philosophy of life
2. Health
3. Food and salter
4. Vocation
5. Family life and adjustment
6. Understanding the environment - physical and social.

Science is the subject of the second, third, and partly the fourth, fifth and sixth points listed above.

How can science help us solve our problems in Transjordan? The problem of catching up with western civilization. The technical part of the problem, that is industrialization calls for science as its sole channel.

Technical schools should be founded and the science program should be revised. Science should be given its due importance. Periods devoted to science should be increased and provided from other less important subjects.

Science teaching with its method, when conducted properly, makes for the liberation of the mind. The attitudes suspended judgment, open and critical mindedness make for intelligent behavior and for getting rid of the cultural lag. IN sum, science teaching, if properly conducted, makes for flexibility of this ever changing life.

CHAPTER ONE

EDUCATION IN TRANSJORDAN

Historical Background.

It is a good idea to have a look at the forest before examining the tree. So before examining science teaching, a brief presentation of education in general with a historical background and development will be made.

During the Turkish regime, Transjordan was under the governorship of the Wali-Viceroy-of Damascus.(1) Conditions in Transjordan were neither settled nor calm due to troubles caused by Beduins who were used to attack pilgrim caravans. The country was divided into administrative units, Kaimakamiats. These units were parts of larger units - Mutasarrifiah - like those of Nablus and Acre.

Transjordan was neglected educationally during the Turkish regime. To know how to read a letter was a rare accomplishments. Sometimes, in order to have a letter read, the receipient was obliged to travel from one village to another where a "Khatib", a literate man, might be found. The "Kuttab" school was the only source of teaching. It consisted of reading the Kuran without much understanding, writing, and some arithmatic. These Kuttabs emphasized religious education. Literacy was considered to be a means of knowing how to read the Kuran, the essence and constitu-

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(1) Toukan, B.A., A Short History of Transjordan, p. 36f.

tion of Islam. The Kuran being highly classical is difficult to understand by young children. Accordingly, they were required to memorize parts of it. As the Kuttab was a one teacher school, the moniter system was used. Pupils sat in rows or circles on the ground and read their assignments with low audible voices. The result was similar to a bee hive-like sound. The population were mostly beduins and farmers in small villages. This privilege of literacy was only available to some children of well-to-do parents.

In the year 1918, the allied forces of the British and the Arabs conquered Syria and defeated the Turks. In 1918 Faisal was declared King of Syria of which Transjordan was a part. In 1920 the French occupied Syria, and Transjordan was left ungoverned. Thereupon, the High Commissioner for Palestine, went to As-Salt, The largest town in Transjordan at that time, and declared that the British government favours the establishment of local self-governments proved with the assistance of British advisors. These local self-governments proved unsuccessful due to lack of cohesion. In 1921 Emir Abdullah, the second son of King Hussein, was invited to come to Trans-gordan to rule. He went to Jerusalem where he met the British High Commissioner for Palestine, and Mr. Winston Churchil who was. Secretary of State fro the Colonies at that time, and they promised that Great Britain would use her good offices with France to restore Syria under an Arab

administration with Emir Abdullah at its head. This was to be done six months from that time. In the meantime, Emir Abdullah was asked to assume rule in Transjordan under the direction of the British High Commissioner for Palestine who represented the Mandatory Power there. An Executive Council of five members and a president was established to administer the country. The British understook to assist Emir Abdullah financially, to keep order and to check the discontented population from committing any aggression against the French. The promise was not fulfilled. A number of rebellions took place but were suppressed by the Arab Legion under the command of Peake Pash. In 1928 an agreement between Emir Abdullah and the British was concluded. The agreement stated that the government of his Britannic Majesty recognizes the existance of an independent government in Transjordan provided it is constitutional and fulfills the international obligations of his Britannic Majesty. A council of siz ministers including a Premier was substituted for the Executive Council of five members and president, mentioned above, to rule the country. These ministers were appointed by His Highness the Emir and were directly responsible, both personally and collectively, to him. In 1928 the Legislative Assembly was elected. Also an Organic Law was enacted.

The educational systamm, no prevailing, was established in the year 1922-23.

Administration.

Education in Transjordan is a state concern, at the head of which is the Minister of Education who is also a member of the Cabinet. Under the Minister is the Undersecretary of State for Education, formerly called the Director General of Education, to gether with his Assistant. There are three district inspectores for the districts of A'jlun, Balqa, and combined districts of Karak and Ma'an. The inspector for the A'lun district. The other two have their headquarters at the Capital, Amman.

The Ministry of Education supervises and inspects all schools government and nongovernment. Government public schools are directly run by the Ministry of Education. Each inspector inspects all subjects in the elementary grades in the schools of his district. He also inspects his subject of specialization in all schools through out the country. Fields of spedialization of inspectors are;

(1) Religion and Arabic.

(2) English and Social studies.

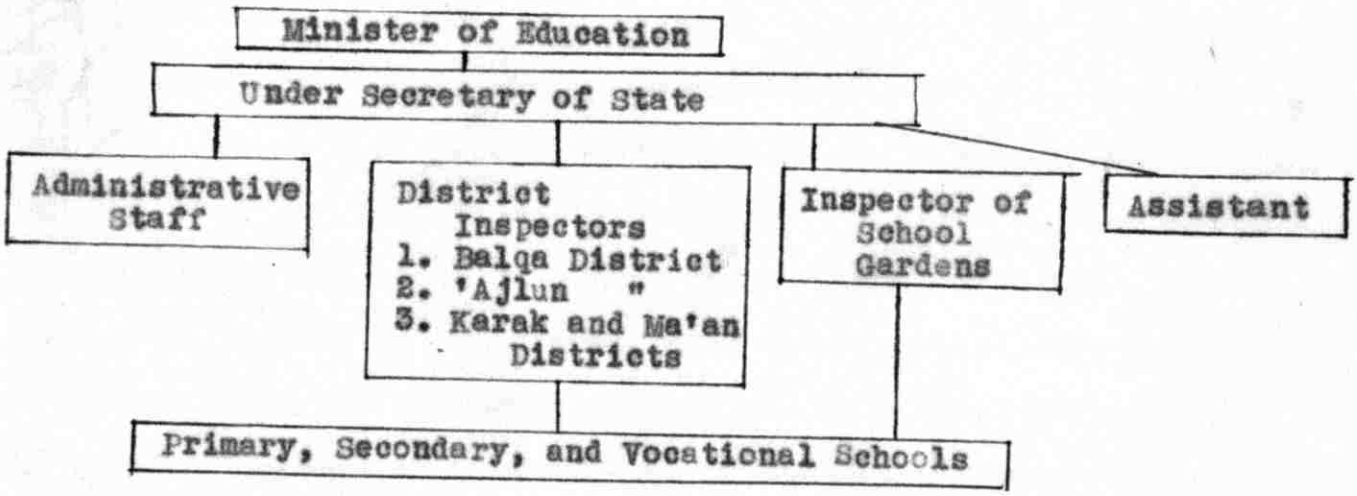
(3) Science and Mathematics.

Inspectors attend classes, watch how the discussion isconducted, and ask questions. They also administer written tests for inspection purposes. These tests are used to evaluate the efficiency of teachers, are in cluded in the students record, and referred to incase of trouble between students and teachers regarding promotion. The inspectors submit reports to the Ministry of Education on the basis of which instructions are issued to principals and teachers of schools. Reports on principals

are also sent to the Ministry of Education. Inspectors also evaluate pricipal's reports on teachers, their appointment, transfer and promotion, the opening of new schools, and constitution of their staff.(1)

Chart I.

EDUCATIONAL ADMINISTRATION



(1) Matthews, op. cit., p. 300.

AIM.

The aim of Education is of great importance because it guides all aspects of the whole undertaking. It determines curriculum, methods, activities and evaluation. But, unfortunately, we do not have a clear and definite statement of educational aims in Trans-Jordan. Education was introduced as an imitation of education in Palestine. This was also true of other aspects of the government. When I interviewed the Director General of Education in the year 1947, he stated that the aim of education was to acheive literacy, and inculcate Arabic traditions, virtues, and other factors which strengthen the national feeling in youth. This year, 1951, the same man who is still holding the same office defined the aim of education as "To produce a student who is an Arab nationalist in spirit, desiring to live as a civilized man." This aim, influenced the curriculum, and resulted in an emphais on the Arabic language and Arabic history. Arab History is now taught in detail all through the school years. In this program, the Arabs are said to be the makers of culture which was transmitted to the West. Teachers are asked to stress the contributuinns of the Arabs in all fields of knowledge.

The sciance inspector wrote me that the schools years are divided into three stages each stage having its specific aim. The first stage, the Elementary, consists of five years beginning with the age seven and ending with the age of twelve. Theaim of this stage is literacy and genceral education for good citizenship.

This stage is compulsory by law. The second stage is constituted of the sixth and seventh primary years plus the first and second secondary years. It begins with the age of twelve and ends with the age of fifteen; its goal is twofold;

a. Preparation for higher secondary education, and

b. Preparation for elementary agricultural, elementary teacher training, commercial, industrial and technical schools.

The Third Stage - Senior High School - is constituted of the third and fourth secondary years. It begins with the sixteenth year of age and ends with the eighteenth. The goal of this stage is the preparation for University enterance and specialization.(1)

THE EDUCATIONAL LADDER.

The educational ladder consists of two steps or stages, primary and secondary. There are no government kindergartens. Public schooling begins with first year primary to which children who completed their sixth year of age and did not exceed the eighth year are admitted. The primary stage is composed of seven grades. The first five grades constitute the lower primary cycle which is called the elementary cycle. In villages, the elementary cycle is of four years. These schools are called village elementary schools. Originally, these schools conducted their own examination, on the basis of which students where admitted to secondary schools, since 1944-45, these examinations have

(1) It is to be noted that this classification is just for curricular purposes.

been replaced by an official public examination conducted by the Ministry of Education.

The secondary stage consists of two cycles, the intermediate and the upper. Each cycle is of two grades. This stage ends with the official Matriculation examination which was begun in the year 1940-41.

There is one technical school parallel to the secondary stage at Amman. It consists of a four years course in carpentry and blacksmithing.

Except for a one year course in teacher training, begun in the year 1950, there is no post secondary education in Transjordan. Students completing the secondary stage can pursue their students abroad if their financial conditions permit.

Finance.

Public education is financed by the state. The educational budget is a part of the general budget. The educational budget did not maintain its ratio to the general budget during the Second World War. In the year 1930-31, it was 6.7% of the general budget; in 1941-42, it became 2.5%; in 1944-45, 1%.(1) This year, 1950-51, it is 2.4%. These figures would be reduced to half their value were the military budget included. The military budget is not under the genaral budget. The army is financed by an aid from the British governemtn according to the Treaty of 1948.

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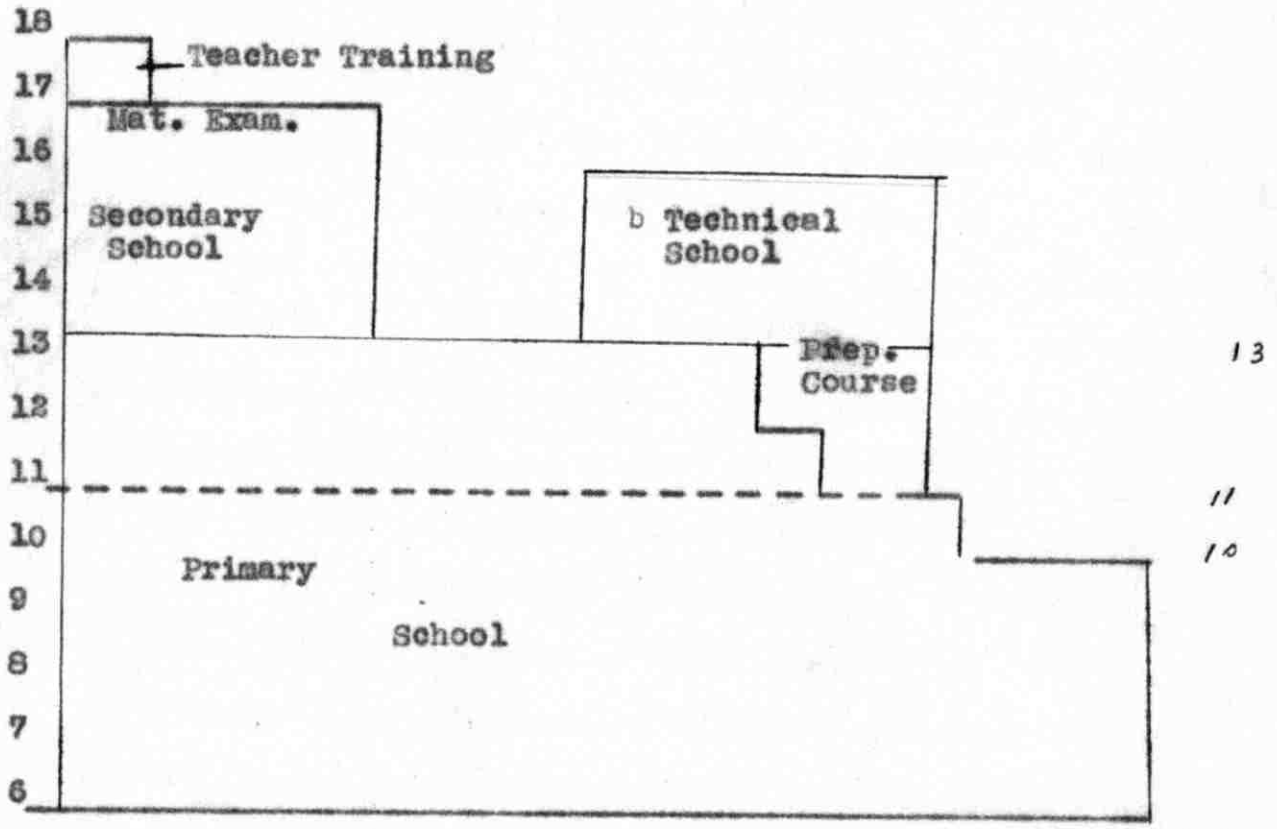
(1) Matthews, op. cit., P. 301.

Chart II.

EDUCATIONAL LADDER



In the year 1947, a municipal tax for education was provided. This tax amounted this year, 1950-51, to 20,000 dinars and the salaries of twenty teachers.(2)

In rural districts, village authorities provide the building of the school. The Ministry of Education provides the furniture, equipment, and teacher salaries.

As the elementary, lower primary, cycle is legislatively compulsory, it is free. From the sixth primary upwards fees are charged with 50% exemption. Those exempted are the poor. The annual charge for the sixth and seventh primary is 2 dinars; for the intermediate secondary 4; and for the upper secondary 6. Each examinee for primary and Matriculation certificates pays a charge of two dinars.(2)

Teachers enjoy the status of civil servants. The civil service is divided into four classes and ten grades. The B.A. holder is appointed in the third class, seventh grade with a monthly basic salary of 17 dinars. Up to this class employees are appointed on the recommendation of the Under Secretary of State for Education and the approval of the Prime Minister. For the upper classes, the approval of the Council of Ministers and the King is necessary. In relation to pension, the teacher is treated as other civil servants.

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(1) Interview, op.cit.,

(2) Ibid.

Development Of The System.

Numbers of schools, teachers, and enrolled students shows a rapid rise in the past half decade. In thefirst nine years begining with 1922-23, the number of schools increased by about 25%, students and teachers by about 50%. In the following decade, schools increased by 37%, teachers by 50%, and students by more than 100% with a higher percentage of increase for girls than for boys. During the Second World War, the number of schools was at a stand still, teachers increased slightly and pupils dropped. The last half decade shows a 92% increase in schools, 132% increase in teachers, and 148% increase in students enrolled. These figures are shown clearly in Table I.

Primary Program.

The program for study of the primary schools for boys is given in Table II. Theprogram for girls differs, in some aspects, from that for boys. One period a week for each of domestic science and nursing is provided in the sixth and seventh grade for girls; one period of child care in the seventh; and a total of thirteen periods for handwork;- all through the six years from the second to the seventh grades.(1)

In other respects the program for girls follows the same lines as that for boys. The religious course is differentiated into two subcourses, the Kur'an and

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(1) Matthews, op. cit., P. 311.

TABLE I.

NUMBER OF PUBLIC SCHOOLS, TEACHERS AND STUDENTS. (1)

Year	Number of Schools			Number of Teachers			Number of Students			Average No. of Pupils/ Teacher.
	Boys	Girls	Total	Men	Women	Total	Boys	Girls	Total	
1										
1922-23			44			81	2998	318	3,316	34.4
24-25	39	5	44	97	13	110	2904	353	3,257	29.4
26-27	46	5	51	100	18	118	3472	442	3,914	33.2
30-31			54			112			4,698	40.5
39-40	64	10	74	174	35	182	7731	1874	9,605	52.6
40-41			74			184	8255	1894	10,150	56.7
41-42			74			184	8365	1999	10,364	56.1
42-43			74			168	7955	1897	9,852	52.3
43-44			73			188	7750	1857	9,607	50.0
44-45			73			197	7645	1844	9,489	47.7
45-46			73			199	7918	1956	9,874	49.2
47-48	70	11	81	190	43	233	9771	3349	12,120	52.0
49-50	89	23	112	281	90	371	15237	3957	19,194	51.7
50-51	110	31	141	362	141	476	19275	5281	24,556	51.6

(1) Matthews, R., Education in the Arab Countries of the Near East, P.306.

An interview with the Under Secretary of State for Education.

العدد الاول من النشرة الدورية التى يصدرها القسم العربى بشعبة الصحافة والنشر
فى جامعة الدول العربية ، نيسان ١٩٥١ .

religious knowledge which includes the sayings of the Prophet. The study of the Kur'an and the memorization of a part of it is aimed to make pupils able to perform their religious rites, especially the five prayers, and to benifit from its literary style. Religious knowledge is given gradually through stories and examples from every day life. True religious ideas are to be presented without any of the superstitions. The teaching of religion is sought as a means for the inculcation of good qualities of character.

The objectives of teaching the Arabic language are to master the ability to read, write and express one's thoughts clearly and correctly. The course consists of reading, dictation, memory work and penmanship all through the seven grades except for the last subject in the last grade. Conversation is introduced in the first grade and continues to the fourth. Grammar is introduced in the fourth and composition in the fifth. Both continue to the end of the primary stage.

The English language is begun in the fourth grade. It consists of reading, handwriting and dictation throughout the course. In the sixth and seventh grades composition and grammar are added.

Physical training is neglected. One period a week for children is quite insufficient. This is a manifestation of the prevalent way of looking at education as acquisition of information in the traditional subjects. The development of the child is

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(1) Matthews, op. cit., p. 311 .

neglected. Six periods a week, devoted to a foriegn language in the fourth primary are, in my opinion a waste of time and effort especially for those who do not continue their stuky in the secondary stage. Physical training of the child is sacrificed for something of practically no use. Keeping in mind the method of instruction and the passive way of learning, we may imagine how uninspiring school life is to the child.

Secondary Program.

The system in Transjordan is a one ladder system. The secondary school is a continuation of the primary. Secondary schools have the primary division in the same building. The upper cycle of the secondary stage is differentiated into two divisions, literary and scientific. The program is heavily loaded so as to meet the requirements of the Matriculation examination. Table III. shows the program of study in the secondary stage.

Regarding religious instruction, suggestions point out what is believed to be gained from such a course, such as spiritual satisfaction for the curious, thirsty adolescent. It is also believed that the salvation of mankind is through religious teachings. The role of the teacher is recognized here, and only here, as the most important factor in the development of the attitudes sought and understandings desired. The Arabic language occupies six periods a week for each of the four years. Grammar, reading - oral and supplementary -, literature, composition and memorization are the major topics of Arabic studied

TABLE II.

Program for studies in primary schools for boys, Transjordan, 1950-51. (1)

Subject	Periods per Week*						
	1st Grade	2nd	3rd	4th	5th	6th	7th
Kur'an & Religion	2	5	5	4	4	3	3
Arabic	14	12	12	8	8	8	8
English	-	-	-	6	6	7	7
Arithmatic	4	5	5	5	4	4	4
Geometry	-	-	-	-	1	1	1
Science	1	2	3	2	2	2	2
Agriculture	-	-	-	1	1	2	2
History	1	1	1	2	2	2	2
Geography			1	2	2	2	2
Civics	-	-	-	-	-	-	1
Physical Training	1	1	2	1	1	1	1
Drawing & Handwork	1	2	3	2	2	2	1
TOTAL	24	28	32	33	33	34	34

*A period is 45 minutes

(1) المملكة الاردنية الهاشمية، وزارة المعارف، مناهج مدارس البنين الابتدائية والثانوية - المكرر.

TABLE III.

Program of studies for secondary schools for boys, Trans-jordan, 1950 - 51.(1)

Subject	Periods per week*					
	1st Year	2nd	3rd Liter.	3rd Scie.	4th Lit.	4th Sc.
Kur'an & Religion	2	2	2	2	2	2
Arabic	6	6	6	6	6	6
English	8	8	9	6	9	6
Mathematics	7	7	5	7	5	7
Physics	3	3	3	4	3	4
Chemistry	1	1	2	2	2	2
Botany	1	-	-	1	-	1
Zoology	-	1	-	1	-	1
Agriculture	1	1	-	-	-	-
History	3	3	4	2	4	2
Geography	2	2	2	2	2	2
Physical Training	1	1	-	-	-	-
Military "	-	-	2	2	2	2
TOTAL	35	35	35	35	35	35

* A period is 45 minutes.

(1) Ibid.

seperately.

The English language is emphasized more than the national language as it is shown in table III. The course is differentiated into reading, composition and translation, grammar, and memorization.

Private Schools.

Private schools exceed public schools both in number and enrollment. The Enrollment in private schools is 30,000, while in the public schools it is 24,556 students.(1)

Private schools are organized under religious and lay auspices. There are private kindergartens, some of which are annexed to private schools. Religious schools constitute a large proportion of the private schools. Private schools follow the public schools curriculum and prepare for entrance to higher schools, whether private or public. The regulations governing the founding of a private school are:(2)

1. Private schools can be founded by a person, a group or a sect. These may be Transjordanians or foriegners.
2. The Ministry of Education must approve the appointment of teachers, texts, and syllabi.
3. The school building should be approved by the Health Department.
4. Every school should teach the Arabic language, History of the Arabs, and the Geography of the Arab countries.

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(1) Interview, op. cit.

(2) امارة شرقي الاردن ، وزارة المعارف ، نظام المعارف رقم ١ لسنة ١٩٤٥ ، نظام المدارس الخصوصية

5. Private schools are liable to inspection.

6. No corporal punishment is permitted.

CHAPTER TWO

THE IMPORTANCE OF SCIENCE IN LIFE OBJECTIVES OF ITS TEACHINGS IN LINE WITH AIMS

Ours is an Age of Science.

Life is a process of adjustment to environmental situations. It is a reciprocal process both of adaptation and control. This latter can be called active adjustment. It is the control of the environment to meet the needs of man. This is facilitated by the control of natural forces which is the fruit of science. The conservation of lives of individuals is facilitated through control of disease and the use of medicines. Natural phenomena are interprete scientifically and not through superstitions and magic. All aspects of life are affected by the discoreries and applications of science. These aspects can be summed up as economic, social, political and educational.

Effect on Economic Life.

Science developed the substitution of machine labour for human labour. This machine labour resulted in the increase in production to balance the increase in population. Sources of food are also controlled. Conservation of the soil is one aspect of that control and its fertilization is another. Better qualities of animals and plants are bread. The control of natural forces- such as floods, diseases, etc. - which caused losses of animals and their products used as food, of crops and otherwise, has been a direct consequences of

science. Plants are also protected against parasite weeds, insects, and other organisms. Means of communication have been so well develop ed that the distribution of commodities greatly facilitated.

Effect on Social Life.

The aggregation of labourers in factories and the dependence of production on them, made them establish labour unions to protect their rights and improve their conditions. Through these unions the role of the labourer came to be recognized by authorities and capital owners. The socialistic movement followed a new trend, that is, a material basis. The result was the Communist Revolution in Russia and the communization of nearly half the population of the world. The better means of communication through science: the Press, the radio, the aeroplane, and other devices make for exchange of ideas and better social understanding both in and out of a group or a nation. Another development is the use of scientific discoveries for military purposes, which makes wars more destructive and dangerous. It has also made for the equality of the sexes. Women proved their ability to share the place of men in factories and to be as efficient as they are. The new educational ideas also made for equal opportunities for both sexes. The woman is entrusted with guiding the child's education and development which begin early in his life, and hence she should be educated. So being at home or at work, she has the justification and right of equality.

Effect on Political Life.

The democratic ideal spread universally. Representative governments are and acknowledgement of the right of the masses to elect their governments. Wars enhanced the realization of this right due to the dependence of armies or individual soldiers who are from the masses. Imperialism in its political and military forms appeared to protect economic privileges of importing raw materials and exporting manufactured goods.

Effect on Educational Life.

Education, as a life process, was affected by the factors mentioned above. Skilled technicians are a necessity of this machine age. The need for their preparation came to be recognized. Education became vocational as well as academic. Proper adjusting ability for this complex mode of life necessitates universal education for all. Also, as equality of political opportunity has been recognized, the only way to put it into effe ct is therefore an equality of educational opportunity. This scientific power constitutes a challenge for eduction. Power in the form of scientific discoveries is put into use, and can be used either for the wefare or the destruction of humanity. It is up to education to build strong attitudes and desires to accomplish peace and brotherhood, and to abolish wars and antagonisms. Here we enter into the relation of science to philosophy of education and of life in general.

Relation of Science to Philosophy.

Science is power. It affects all aspects of life. This pow er is abused when there is a conflict of social desires. This conflict leads usually to a clash. So to prevent the clash, the conflict should be resolved, and sharing of interests should be the substitute. How can this be done? Can we just preach people to share interests and discard antagonisms? Or should we look for a practical device? Yes, we should find the fundamental poin t of departure of interests, the base on which differentiation rests. Every conflict between interests rests on such a distinction which is protected by the favored and attacked by the deprived. So as long as these distinctions persist, conflict follows. This is the crucial need for a philosophy to resolve social conflicts. This philosophy which is sought, uses the power which science gives to achieve its solution, a state of social equilibirium or balance.

Science, philosophy, social change, and education affect one another. According to Dewey, the series begins with science and proceeds to industry, social change, education and then philosophy.(1) Science is applied in industry. Industry promotes social change which is manifested in education. Education, for its part, looks for a philosophical basis to lift itself from being a mere routine. This philosophy is mostly concerned with attitudes, desires and interests. Science provides subject matter and method to achieve the desired ends in the desired orientation. Science, for itspart, affects education in :

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(1) Horne, H., Democratic Philosophy of Education, P. 470.

1. modifying the habitual attitude of imagination and feeling,
2. creating an intelligence believing in its own ability to manage human affairs, and
3. changing man's ideas of nature, and possibilities of human experience.(1)

Now, to what extent does this progression work? Science changed the social order but did not change the whole series with the same magnitude. The social order still holds some of its standards and measures; education still has traditional subjects and follows traditional methods. Attitudes and morals of the past still exist wholly or in part. These all constitute what is called the cultural lag. Social order, education, and philosophical ends and attitudes lag behind scientific advancement. The obstacles are traditions and customs. These two obstacles denote a lack of philosophy. The problem is grave here in the Near East because of the superficiality of the change we undergo even in scientific advancement itself.

Objectives of Science Teaching

The educational process is a unity. Objectives, subject matter, method and organization, and evaluation are strongly interrelated as it is shown in the diagram below.(2)

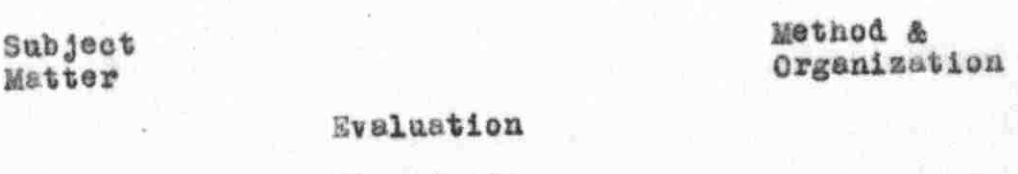

Diagram I.

(1) Horne, H., Democratic Philosophy of Education, p. 301.

(2) Gile, H., Exploring the Curriculum, p. 1,2.

The objectives of any branch of knowledge should contribute to the attainment of the general aim of education.

The aim of education in Transjordan was described in chapter one as being neither clear nor definite "An Arab nationalist with ability to live as a civilized man" is ambiguous. What is a civilized man? Is he the one who applies scientific discoveries? Is he the one who is skilled in war? Or is he the one who exploits others within his nation or out of it?

The aim of education should be derived from its meaning. What is education? Is it life or preperation for life? The answer to this question depends on the concept of the individual and society. To be conceived as preparation for life implies subordination of the individual to society and denies his individual freedom. It also views life as static. The other meaning of education as life, as being its own end, views the individual as unique, intelligent and able to adjust himself in future novel situations through application of what he learns in the present. Life is dynamic and so it is not wise to standardize individuals to something which is not known. Education is growth in the present. But what is the quality and purpose of this growth? It is dynamic growth which promotes more growth.

"Education is a continuous reconstruction or reorganization experience which adds to the meaning of experience and which increases ability to direct the course of subsequent experience."(1)

(1) Dewey, J., Democracy and Education, p. 89.

Growth develops through interaction. So interacting forces should be taken into consideration. Initiative of the learner is a dynamic force to be started with. Environment makes for the realization of capacity and initiative. Growth is a change from what is to what is desired. It is a movement in a direction. The direction or orientation is determined by environmental pressure. The growing individual is found in a social setting. He can not live nor grow in isolation. Experience and activity are unattainable except in a social situation and through social intercourse. So, the more the social intercourse, the richer the experience. Social stratification is uneducational. Intercultural intercourse, and co-education should be encouraged. Human understanding and tolerance are aims. Nationalistic sentiment and racial prejudice should be abolished in as much as they cause wars and destruction. Here, a universal democratic ideal is adopted. Interest sharing arrived at through individual freedom and development in a communicative situation is to be attained.(1)

Objectives of science teaching in Transjordan are differentiated according to stages of the ladder. Objectives of elementary school science are:

1. To develop appreciation of nature.
2. To develop keenness of observation.
3. To arouse curiousity and use experimentation to satisfy it.

(1) Dewey, J., Education Today, p. 289-293, 299.
Brubacher, J., Modern Philosophies of Education, p. 331.

(2) A letter from science inspector - Appendix.

4. To induce rules of health from the life of the child and the community.

In the intermediate secondary cycle (Junior High School), objectives are the preparation for the entrance to High School, Secondary and Technical. In the upper cycle of the secondary school (Senior High School), the objectives are the cultivation of interests in practical scientific research, habits of exactness, and correct scientific thinking.

We see that the objectives are not thessame all through. The Saltatory Theory of Growth, and preperation for higher institutions are still manifested. Other things are that teachers are not trained, and equipment is lacking; so the accomplishment of these objectives is questioned.

How can science teaching contribute to the attainment of the general aim of education? In our age of science we have to make adjustments to new situations. These adjustments are to be made by relating previous knowledge to the novel situation in which we are involved. The operation of adjustment, then, depends basically on knowledge. This knowledge is associated to the new situation in a way-method. The whole operation is oriented in an emotional and intellectual setting-attitude.

Knowledge, method, and attitudes are the objectives of science teaching. They are comprehensively stated in the following form.(1)

(1) Fourty Sixth Year book of the National Society for the Study of Education, p. 28-29.

Objectives of Science Teaching:

A. Functional information and facts about such matters:

1- The Universe.

2- Living things.

3- The human body.

4- The nature of matter.

5- Energy.

6- Contributions of science to Civilization.

B. Functional concepts:

1- Vastness of space.

2- The earth is very old.

3- Reproduction of life.

4- Electrical structure of matter.

C. Functional understanding of principles:

1- Changes of reasons in terms of relation of earth to sun.

2- Energy can be changed from one form to another.

3- Elements compose matter.

4- Interdependence of living things.

D. Instrumental skills such as ability to:

1- Read and understand science content.

2- Manipulate science equipment.

3- Read and interpret maps, charts, and graphs.

4- Make accurate measurement.

E. Problem solving skills such as ability to:

1- Sense the problem.

2- Define it.

3- Gather data.

4- Make tentative hypotheses.

5- Select most probable one.

6- Test hypothesis.

7- Accept the tested hypothesis, tentatively or test others.

8- Draw conclusions.

F. Attitudes such as:

1- Open-mindedness.

2- Intellectual honesty.

3- Suspended judgement.

4- Enquiring mind.

G. Appreciations such as the appreciation of:

1- Contributions of scientists.

2- Cause and effect relationships.

3- Uses of science.

H. Interests such as:

1- Interest in some avocational aspect of sience - a hobby.

2- Interest in a branch of science as a vocation for future career

If we analyse these objectives we find that they fall under three larger headings. These are:

1. Information,

2. Skills and habits, and

3. Attitudes.

Information covers facts, concepts, and principles. Understanding of this information is stressed. It is best manifested in functional application in real situations on the one hand, and i n interpretation

of natural phenomena on the other. Skills and habits include instrumental skills and problem solving. Attitudes include attitudes, appreciations and interests. The last two objectives, that is skills and attitudes, depend on information. These objectives are of use mostly in that they are to change the behavior of the individual, through a better understanding of himself and of his environment, so as to secure maximum satisfaction through social cooperation.

CHAPTER THREE

CURRICULUM

ITS SELECTION, ORGANIZATION, AND DIFFERENTIATION

In the last chapter, the aims of science teaching were discussed. The step following the determination of objectives is done is called the curriculum. Naturally, the device must harmonize with the objectives. Accordingly, different objectives of science teaching must have different approaches.

In Transjordan, science study begins in the first elementary class with "object lessons" which include a study of non-living things, plants and animals. This course continues all through the first three grades. Health habits are discussed and encouraged. In the fourth and fifth grades, the animal kingdom is studied with a stress on animals known to the child, as well as health problems such as digestion, blood circulation, respiration, first aid and some diseases. Agriculture is introduced in the fourth primary and continues to the second secondary. Its study is bookish especially in city-schools. The topics studied are: plants, their parts, the kinds and uses of roots, stems, leaves, flowers, and seeds; the soil, its constituents, irrigation, and forests; the cultivation of cotton, tobacco, watermelons, etc.... ; tractors and harvest machines; plant parasites, insects, diseases, weeds and field mice; kinds of food and their preservation, syrup making and marketing of agricultural products.

Health study is resumed in the seventh grade. Diseases of the eye, alcoholic drinks, coffee and tobacco, malaria, smallpox, typhoid, and artificial breathing, are the important topics studied.

Physics, as a seperate course, is introduced in the sixth and continues in the seventh primary. In the sixth it occupies the whole science course. The topics studied are: states of matter, its general and specific properties; pressure, liquid pressure, floating bodies, air pressure, pumps; heat, evaporation boiling, melting, freezing; and the lever, its uses, laws, levers in the human body. In the seventh grade physics shares the science course with health and chemistry but it is studied as a seperate subject. The topics studied are; magnetism and the magnetic needle; static electricity, the magnetic field of current, the electric bell, the electric lamp; sound, its speed, echo, and the ear.

Chemistry is also introduced in the seventh primary as a seperate course. Elements, compounds, mixtures, physical and chemical changes, sulphuric and hydrochloric acids, oxygen and properties, combustion, hydrogen and nitrogen, their properties, air and its constituents, carbon, charcoal, calcium oxide and its properties are the topics studied. In the secondary stage, physics, chemistry, zoology, and botany are studied as seperate courses.(1) Physics is the one stressed more than any other as it is shown in table 3. It is given all through the secondary years.

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(1) See Appendix.

Properties of matter, hydrostatics, heat and sound are studied in the first secondary; mechanics, magnetism, static electrisity, dynamic electricity, and light in the second; hydrostatics, heat, properties of matter, light, and sound in the third; mechanics, magnetism and electricity in the fourth. Topics studied in the first two years are repeated in the last two with some detail.

Chemistry is given also in the four secondary years but with less stress. States of matter, chemical changes, ~~see~~ solubility, solutions, combustion, the air, oxygen, hydrogen, water, nitrogen, carbon, metals and non-metals, acids, bases and salts are studied in the first secondary; symbols, gas laws, laws of chemical combination, equations, metals and non-metals, and preparation and properties of some elements in the second; some of what was studied in the first two years with the addition of oxidation, reduction, molal, normal, and molar solutions, indicators, catalysts, and some elements, their preparation, properties and compounds in the third year; another number of elements and their compounds, ionic theory and some organic chemistry in the fourth year.

Botany and zoology are relatively neglected. Botony is introduced in the first secondary. One period a week is devoted to it and continues on the same basis in the upper two years after skipping the second secondary. Definition, importance of botony, the cell, principal plant parts and plant nutrition are given in the first year. The plant cell, and plant parts are studied again in the third year with the addition of Algi and Fungi. In the fourth year, plant physiology is taken, stressing growth,

functions of roots, stems and leaves.

Zoology is first introduced in the second secondary. Like botony, it occupies one period a week which continues in the upper two years. The animal cell, its constituents and functions, unicellular and multicellular animals, and vertebrates are studied in the second year. In the third year multicellular animals in detail, mollusca, echinodermata are added to unicellular animals which were studied in the preceeding year. In the fourth year, the third secondary topics are reviewed with the restudy of vertebrata including amphioxus, pisces, amphibians, reptiles, aves, mammals, and social life in the animal kingdom, e.g. bees.

(1)

TABLE III

	Periods Per Week					
Subject	1st.	2nd	3rd literary	3rd	4thl.	4th sc
Physics	3	3	3	4	3	4
Chemistry	1	1	2	2	2	2
Botony	1	-	-	1	-	1
Zoology	-	1	-	1	-	1

We see how science teaching follows a curriculum affected by its objectives which are preparation for higher institutions. This is manifisted in teaching seperate logically organized branches or subjects of science. The curriculum in Transjordan is both serial and preparatory. Different stages of the school years have different subject matter. These subjects are taught to prepare

(1)

for something and not for their intrinsic worth. The preparation is for promotion to highter learning stages ending with the preparation for University entrance. The learner is fitted to the thing learned which is "fixed in advance." There is a dualism between the learner and the thing learned; between the child and society. The child is the loser in this supposed conflict. His learning is mere acquisition - passive. Knowledge is taken from an authority, a book or a teacher. This is what is called the pipe-line theory of knowledge. It views authority as a full vessel and the learner as an empty one which is filled from the former through a pipe. Content is imposed on the learner and education is reduced to mere discipline. The learner does not participate in choosing his subject matter and so interest is lacking. The curriculum should be a part of the experiences of the learner, but in Transjordan, he is not taken into consideration. They do not begin with his present needs and environment and so the subjects he studies are strange to him. He is not taken to the field to see some plants and study them, neither given related topics to enlighten his understanding and make his knowledge significant and functional. The teacher should try to make the best out of what he has. At least he should bring some plants to the class or ask students to do so in order to make his lesson in botony living and interesting.

What is the alternative? Who should determine the curriculum? The learner and the teacher should cooperate in lying down what is to be studied. That does not mean that the teacher would be passive. The whole educative process should be dynamic so as to result in dynamic growth. The responsibility of the teacher is magnified according to this point of view, he is to guide the learner and stimulate him to choose desirable responses. From this responsibility stems the importance of teacher training. The teacher should know the psychology of the learner to guide him to accomplish his difficult job effeciently. He is to reconcile social needs with individual development and interest. In other words, the learner should be stimulated to act in a way which is interesting to him and beneficial to society of which he is a member. This is determined by the objectives of science teaching. The Department of Education in Transjordan should give some independence to the teacher in choosing subject matter according to the above mentioned disussion. This, of course, assumes that the teacher is trained and capable of bearing the responsibility. The problem of teachers and their training will be discussed later.

curriculum construction

According to the National Society for the study of Education, the psychological criteria for the selection of a science curriculum should be:(1)

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(1) Thirty First Yearbook of the National Society for the Study of Education, P. 75.

"1. Functional learning is that which relates most directly to the life situations that challenge interest.

2. A task of the curriculum worker is one of making arrays of experiences from which functional learning may result.

3. A task of the teacher is one of making certain that the student profits from learning experiences. The outcome of learning must be identifiable to the learner.

4. Specific objectives are selected for their value to the pupils both in the present and in the future, and responses are taught which these objectives indicate as desirable for the pupils to learn to make."

This can be done by starting with what is interesting, known, and relating it to the new, to what is to be known. It can be applied in Transjordan, as in any other country, as it was mentioned above through field trips in botany for instance. The second point in the quotation above is related to the first one. Learning of important things which are of direct significance is functional. This necessitates stress of community needs as the channel of development of the learner. His development and learning are to be of practical use - fu funcional.

Social need determines the content through social pressure on the learner and through the teacher. Psychological principles devise the way of introductions The Fourty Sixth Yearbook on education describes the desirable curriculum as "flexible curriculum which suited the needs of the children and of society."(1) In the Thirty First Yearbook, thirty eight specific objectives are suggested. These were taken from longer

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(1) Fourty Sixth Yearbook, op. cit., P. 70.

lists of objectives which were arrived at through questions asked by learners and through what seemed to be important to the layman through questionnaires.

Organization.

Subject matter alone is not important, but the way in which it is organized is also important. Fitting the child to subject matter is manifested in an organization in the from of systematic fields of science. This is the situation prevailing in Transjordan. The curriculum does not come out from the experience of the learner. It is not the growth of the learner, but the acquisition of facts. Physics is studied in the sixth primary with an organization of topics such as density, pressure, heat etc. Chemistry is also introduced and studied in a specialized form of organization. It is organized around topics and not problems. The organization is not for a secondary student who is to use these facts in the interpretation of natural phenomena, training in scientific method and attainment of scientific attitudes, but for a specialist who considers topics seperately.

This way of organization is rigid and static. It is not natural. It is like studying spelling, pronunciation, and punctuation each in a seperate period while these three skills combined are needed in writing a letter which is a conduct goal. (1)

(1) Melvin, G., Activity Program, p. 118.

To clarify the situation, we should refer to the objectives and psychology of science teaching. The functional understanding of facts, concepts, and principles which enables the learner to apply and use them in interpritation of natural phenomena, necessitates the coordination of facts derived from many fields of science around these natural phenomena. Facts are means and not ends. A problematic situation may call for information from more than one field of science. These facts should be related to the situation. So a course of general science is preferable to isolated courses, in the elementary and junior high school. A more differentiated course centering around different large fields is preferable in the senior high school as it is proposed later in this chapter. As to planning within the course, it should be divided into units. These units, which should center around a major aspect of the environment, should be divided into smaller problems of significance and interest to the learner. Change of the surface of the earth as a generalization can be divided into smaller topics, as the change of the bed of a stream or a river; then that of a mountain after rain due to loss of soil, then this can be extended to shrink ages and the folding of land from under the water. In this later respect fossils of sea animals can be mentioned as a proof. These problem situations should be attacked in a way so as to give training in elements of problem solving. According to the Fourty Sixth Yearbook,

the sequence in which these problems are organized should be in a spiralling and enlarging pattern of growth in concepts and principles. A more comprehensive statement of this kind of organization is:

"The process of learning is one of building up higger and bigger, that is more comprehensive, ideas. This committee postulates the definition of a major generalization as one which is built up of growing understanding of principles that in turn are developed from smaller ideas that are the product of necessary and desirable experiences in living."(1)

Now, what are these generalizations or units centering around a major aspect of the environment? Some of them may be given here as an example.(2)

1. Adaptation of living things to their environment.
2. Interdependence of living things.
3. Change of the sufraoe of the earth due to natural forces.
4. Meteorological phenomena and causes.
5. Transformation of energy.
6. Relation of earth to other astronomical bodies.
7. Cause and effect relations.

More general and larger units are thos e stated in the second chapter under the discussion of objectives, especially under the functional understanding of facts, concepts,and principles.

Differentiation.

After determining subject matter, the question of its differe ntiation to different school years arises. In Transjordan, this is done by assigning different subject matter to different years. Physics is studied as a seperate subject in the sixth

(1) Dewey, J., Education Todgy, p. 12.
(2) Heiss, E., Obourn, E., and Hoffman, Ch., Modern Science Teaching, p. 63.

primary and continues up all through the ladder. Health study ceases in the secondary stage. This kind of differentiation rests on the saltatory theory of growth. The gradual theory of growth prevailing now necessitates a differentiation which suits it. The generalization constituting units of the program should continue to do that through the school years. Changes in content should be of gradual nature. They should accompany the change in growth of the child. The desired outcome is a concomitant growth in the functional aspect of the objectives which are to continue the same all through. Generalizations are broken down into principles, concepts, and facts which can be differentiated to grades according to maturity of children. This idea of differentiation which rests on continuity of objectives and generalizations of subject matter with growth of the child or learner, coincides with the progressive point of view of education as growth, reorganization or reconstruction of experience.(1)

But how should we differentiate? According to what specific criteria? Heiss gives the following:(2)

1. In terms of broad concepts and principles.
2. In terms of adjustment needs of children.
3. " " " interests of children.
4. " " " growth level of children.
5. " " " level of difficulty.

Another point is added to these from the Fourty Sixth Yearbook. Subject matter for a certain grade should be of direct use to children in every day life.

It was pointed in the preceding discussion of organization that a general science course is prefered to seperate courses of

(1) Dewey, J., Education Today, p.12.

(2) Heiss, op. cit., p. 63.

different fields of science. This is better limited to elementary and junior high schools. In the senior high school, three specialized courses of biology, physics and chemistry aree suggested to be elected by those who intend to enter college.(1) The Thirty First Yearbook demands some integration of physics and chemistry. But what about other physical sciences? What about geology, astronomy physiography? To be fair to these sciences and not to go to extremes in specialization, the three years of high school should have:

1. An integrated course in biological science;
2. " " " of physics and chemistry;
3. " " " of astronomy, geology and physiography.

The integrated course in biology should include zoology, botany and human physiology.(2) It should include materials related to:

1. Health - food, nutrition, safety, and mental health.
2. Reproduction, heredity and environment.
3. Structuree and functions of living things especially tne human body.
4. Conservation of living things.
5. Conditions necessary to support life and adaptations of living things.
6. Living things of the past and changes which took place.
7. Relations between individuals, groups, and living things in general.

Experience in chemistry should proceed from concrete materials to symbolic discussions. The organization of content should not be rigid and traditional. It should center around principles rather than substances as is the situation in Transjordan. The guides put for the study of chemistry by the Fourty Sixth Yearbook are:(3)

1. Satisfaction of real needs.
2. Adequacy to maturity of the learner.
3. Socio-Economic applications are to be stressed.
4. Activities to develop attitudes and method of problem solving.
5. Pupil interest to be taken into consideration.

(1) Fourty Sixth Yearbook, op. cit., p. 183.
(2) Ibid, p. 184.
(3) Ibid, p. 199.

CHAPTER FOUR
MOTIVATION, METHOD, AIDS, EVALUATION, AND TEACHERS.

Method is the way through which subject matter is applied to reach perceived ends. So the way subject matter and objectives are viewed and their relation to each other and to method determines its nature. The production of an Arab nationalist living as a civilized man as an aim with an imposed curriculum necessitates an authoritari method of application.

in the elementary stage, science teaching is better and its contents are better adapted to the needs of the children than scienc teaching in the intermediate and upper stages. Its objectives are related to child development and consider the child's intersts. The inspector in science teaching advises teachers to make sure that subject matter bears on the child's every day life experiences.(1) The example he gave of the way he recommends is:

A. Our cat: kinds of cats in relation to color and size, their little ones, how do they play?, how does their mother watch them?, how does the cat respond to mice and birds?, And what does ou cat eat?

B. Our dog: what does the dog do in the day?, what are the kinds of dogs as the observations of the child indicate?, what is the relation between the dog and the cat?

This information is taught in the first primary.

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(1) Aletterform the science inspector*-see appendix.

But even here outdoor trips are not mentioned. Activity is neither suggested by the inspector nor done by the teacher. Object lessons are studied passively. The teacher speaks about objects and health and pupils read about them in the textbook. They read about them but they do not contact them. The things they know they do not contact consciously, and those the do not know, they only read about.

In the two following stages, objectives are preparatory. Teachers are adivised to pay attention to the practical side of science that is, laboratory work. But even this isnot fulfilled due to lack of equipment and shortage of time because of the crowded character of the curriculum which leads the students, finally through the public examination, the matriculation Certificate. Thus, according to these requiremnts acquisition of information and facts is the only aim, while laboratory work and experimentation are sacrifieced. A session on magnetisim for thesecond secondary class in Hussien school at Amman was conducted as follows:

1. Review of the previous sessions discussion done completely by the teacher. He spoke about the manifestation of magnetism, the magnetic needle, and the law of attraction and repulsion. He himself solved a problem on that law as an example which was copied by the students.

2. The teacher then entered into a new discussion of the magnetic theory. He presented the theory saying that a magnet was made of small magnetic particles arranged in a certain manner. Then he

proved that by the phenomenon of saturation of a non-magnet through th operation of mechanical magnetization and the arrangement of iron powder in a test tube when mechanically magnetized.

3. He demonstrated the magnetic field and had the pupils leave their desks by threes and go to his table to see the demonstration. Then the bell rang but he continued for one minute and gave the assignment. Thinking over the methods followed during this session we would notice that at least the review should have been done by the students. The magnetic theory was not presented scientifically. In stead of giving the evidences first and then concluding the theory the opposite was done. How can we expect to cultivate a scientific method of thinking when science material is presented to the students unscientifically. Demonstrating the magnetic field was a good idea but students moved in a disorderly manner. The last thing done was delaying the students, in other words, stealing their time which has a bad effect both on their attitude and feeling towards the teacher.

A laboratory session is a rare event. It may occur once a month. Because classes in secondary schools are large, usually more than sixty students in a class, the class is divided into two divisions each working one period of fourty five minutes. Then, they are further divided into two or more sub-groups each performing a differe-nt experiment. This is done because sufficient equipment is not available to have each student work individually. Pupils follow instructions which are read by one of them while another works and the others watch. Another method followed where the teacher performs

the experiment while students watch. The experiment done is always to demonstrate a studied phenomenon or theory. In other words, the deductive method is follwed. The theory is studied and accepted, and so results of the experiment are anticipated. The procedure is thus biased. The laboratory should be used with the following guides in mind:(1)

1. Use the laboratory work to give the pupils practice in raising and defining worth-while problems.
2. Pupils should learn the meaning and use of control in experimentation; one variable at a time.
3. To test hypothesis and interpret data.
4. Student exploration accompanied by teacher guidance.

Analysis.

From the forgoing discussion, we see that the method used in teaching science in Transjordan goes side by side with objectives and curriculum. Objectives are preparatory. They are for the preparation of some thing fixed in advance, the entrance of a higher institution, which requires certain qualities. Unfortunately, these qualities are mostly information. The curriculum is fixed in advance to satisfy these requirements. They are to be possessed by the learners, who is to be prepared. The most economical way to reach these objectives is to store the information designated in his head and be ready to reproduce it on demand. So the authoritative nature

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(1) Fourty sixth Yearbook, op. cit. p.35-36.

of objectives is thus translated into curriculum and method. Objectives are imposed on the learner who does not share interest in them. Curriculum is external to the learner because he does not participate in its determination. Method follows the same procedure. The learner is to be insturcted, that is , to have a structure built into him. Information is viewed here as an end in itself. Method is rigid and stagnant by being passive. Discipline is the policy followed. This kind of discipline is authoritative. But how can learning be accomplished if the child is not interested in the understaking? It is facilitated through artificial stimuli, examinations, rewards, and punishment. Here effort is seperated from interest. We are back to the dualism of the authoritative practice of education .

Let us look for the real meaning of interest and its relation to effort. The Latin word "Interwest" means "In-between" It is an attitude of mind towards an end; it ispurposeful. The mind with an attitude towards an end is under tension to attain that end. But does interest come from a vacuum? No, interest begests interest. It depends on knowledge. This concept of interest coincides with the idea of growth as reconstruction of experience. Knowledge - information pluss experience plus feeling -should invoke more knowledge, more learning, more growth. From this we can infer that a successful teacher is one who relates the new to the old, the thing to be known to the thing known already. To be interested is not all. Interest with out effort is dead interest which can not be conceived of. It is not interest, but it is indifference. When one is interested he is

not indifferent, but active and anxious to reach his goal. Another thing is that interest is not static but dynamic. Interest spurs effort; effort ends with accomplishment whcih in its turn strengthens interest and may invoke new interests. Nothing succeeds like success. And according to this view, the learner should always be conscious of his progress because it is a generator of both interest and effort. Knowledge thus attained is wider and more durable. Further more, this attitude of learning is more efficient in time and effort. These advantages stem from the importance of feeling in and towards experience. It generates effort in experience and fosters the results of it. But here rises the question of conflict of interests. When two interests oppose each other, the one to follow is the one which leads to reconstructis growht. The teacher as a guide should step to make the learner follow the preferable one himself. And that is not to be done through impostion, but through preparing a desirable atmosphere, enviroment. The teacher's wisdom and the proper enviroment are also needed in presenting social values to the learner. To follow the interests of the learner blindly leads to hedonism. He may follow the line of least resistance and try to do easy things, or he may do something which is socially harmful. Education should be life like socially as well as practically. It should take into consideration significant problems and begin from concrete, situations which are interesting. It also should take into consideration that life has difficult things to be done. (1)

(1) Brubacher, op. cit., p. 261-266.
(Horne, op. cit., p. 162-163.

The importance of interest in education implies beginning with the interest of the learner. This necessitates an organisation of subject matter to fit it. In Transjordan the organization is logical. It proceeds from the simple to the complex. But simple to whom? It is simple from the point of view of the teacher. In the study of sodium and its compounds, it is begun with sodium, its properties and preparation, and then sodium chloride comes. The opposite should be done. ~~The opposite should be done.~~ The student knows sodium chloride but does not know sodium; so it should be begun with what he knows.

The logical organization implies a suspicion in the ability of the human mind to organize experience logically, so it is imposed from without through subject matter. This dualism between organization of subject matter and the learning process makes for bad adjustment due to lack of motivation and interest. Another thing is that experience is not complete. Order is always relative to aim and values; organization isinfluenced by interest. This necessitates starting with the child's interest by starting with what is known to him. This is the psychological organization. It follows both the inductive and deductive methods. It begins with an interesting point, a problem, then its definition, a hypothesis as a tentative solution, testing the hypothesis, and lastly evaluating the whole

procedure. The last step aims to see generalizations or a summary. It is deductive. It is to discard shortcomings and mistakes.(1)

The problematic situation was found to be necessary for the educative process both from the point of view of interest and organization. It implies freedom of action. The individual works for himself on the problems he meets. This does not mean that he is unsocial. On the contrary, his problems have a social value because he senses them through social pressure. But it is the ability to work independently and reach decisions in novel situations when he does not have his teacher or parents to think and work for him. The changeability of life is a strong factor which backs this argument. Another thing is that pupils are not alike, but they have individual differences. The problematic method capitalizes their individual abilities. Some of them would go further than others in exploration and application of the problem. This method necessitates activity. According to Morgan,(2) no child is born lazy. He is not to sit in a class with folded arms but he is to do things and take work as a pleasurable activity. The thirty first Yearbook views a learner as an individual with inherent tendencies towards activity, with the ability to respond towards his own activity in terms of satisfaction and annoyance, and to reflect arriving at proper adjustment or mental disturbances. This means that either he is adjusted or

(1) Brubacher, op. cit. p. 278-281.
Herne, op. cit., p. 290-294.

(2) Morgan, ., Child Psychology, p. 219.

maladjusted. The kind of adjustment depends on satisfaction or lack of it. In the latter case it leads to mental disturbances. The proper adjustment is the satisfactory reaction to annoying stimuli. Ability to meet new situations is satisfying and gives security in the struggle for existence. Activity is not only important in initiating and exploring problems, but it is also important for testing the hypothesis in action.

The problems to be dealt with should be real and significant to the learner. Heiss (1) gives an example of how a real significant problem to a class was solved. The class was going to a picnic on a week end. The weather-man predicted that Sunday would be sunny but his prediction did not come true. The class was divided into two groups, one saying that the weather-man always lies; the other being moderate, saying that his predictions come true most of the time. The problem was defined and the two hypothesis were stated. Then predictions were taken and their coming out true were registered. After a sufficient number of these observations the results were matched and the moderate hypothesis was found to be the right one. In this case, the children were very interested and they acquired the ends of problem solving - knowledge, technique, and the attitude of suspension of judgment.

The steps in solving a problem are: (2)

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(1) Heiss, op. cit., p. 137

(2) Fourty Sixth Yearbook, op. cit., p. 166-67.

1. Sensing the significance of the problem arousing interest.
2. Defining the problem-situation in clear English. Verbs of change are to be used in question form, i.e. How does one avoid contagious diseases.
3. Studying the situation for all possible clues and facts bearing on the problem, charts, films, field trips, models, and graphs. One should be critical about books.
4. Making the best tentative hypotheses.
5. Selecting the most likely hypothesis.
6. Testing hypothesis by experiment or other means.
7. Accepting tested hypothesis tentatively or testing other hypotheses.
8. Drawing conclusions.
9. Applying principle in new situations.

The equipment to be used and its manipulation are to be carefully planned, so as to economize time. It should preferably be from the environment of the child. To illustrate the expansion of air on heating, it is better to use a balloon rather than a chemical flask for demonstration. Field trips are of most use to afford first hand knowledge. Motion pictures, slides, globes and charts within reach of the child are of most benefit.

Through problem solving, questions are answered, that is, facts are obtained, which are found in relationship and not acquired as independent entities. Attitudes of suspended judgment, open and critical mindedness are fostered in the only way they can be - in practicing them in the solution of problems. Skills of method are mastered in practicing scientific techniques and

thinking. The steps of problem solving are the same as those of thinking, which should be scientific and free from bias and dogmatism so as progress can be facilitated.

"Thinking is a process of dealing with recalled facts and experiences... The recalled facts are ones that are associated (or seen to be associated) with the problem situation that has stimulated thinking."(1)

The quality of an education one receives can be judged by its effect on his thinking. The ability to act satisfactorily in novel situations depends on the thinking of the individual which directs his actions. Problem solving makes for a good quality of education. It naturalizes and socializes education in the sense of making it life like. Growth of the learner is not in information coated with a feeling and an attitude - experience. The fallacy of the passive method is in stressing information only. From this practice education came to be unpractical, and abstract. This is manifested in descriptive phrases attributed to abstract and unpractical opinions as being academic, bookish, etc.. Graduates, entering real life recently, are described as fresh from college, inexperienced, utopians, etc.. This is the crucial problem we have. Education should not be separated from life. It should be reorganized so as to make for the development of experienced

(1) Thirty First Yearbook, op.cit., p. 67.

growing individuals. The school years are a waste of time if they are not utilized to this end, Life is a process of continuous adjustment. In other words, It is adjustability and not adjustment which is important. Adjustment to the present only, and not to the future which garantees this end, is the right adjustmetn. The present should have "situations of novelty developing experience."

This method was found to be successful in the study of the eight-years done by thirty progressive schools in the United States. Graduates of these schools earned higher averages in all subject fields except in foriegn languages. They also possessed a high degree of intellectual curiosity and drive; demonstrated a high degree of resourrce fulness; participated more in all organized student groups; and had a better orientation towards the choice of a vocation.(1)

Materials.

Materials or teaching aids used in science teaching in Transjordan are limited to textbooks and, partly, to laboratory equipment if available. Multi-sencory aids like motion pictures fils, and slides are not used. Field trips are never resorted to. The radio, with its value of opening new areas of interest is not used. Extensive reading in science books and magazines are both not though, of and not available. Text books are adhered to without deviation or modification.

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(1) Aikin, W, The story of the Eight Year study, P. 110-112.

Textbooks are determined by a committee of science teachers appointed by the Ministry of Education, and of inspectors under the chairmanship of the Under Secretary of State for Education. Their decisions should be approved by the Minister of Education before they are put into effect. In case books on a certain subject of science are not available, as it is for the upper secondary classes in chemistry, the teacher translates materials from different sources and presents them to students in a lecture form. Sometimes these translations are mimeographed for the students' use. Curriculum and method are not only authoritative, but they are centered around a text which is the only source of information and which is followed blindly. This situation should be changed. The text should be considered as a tentative plan, and other sources such as books and magazines, should be available, in the classroom and the library, for extensive reading.

Organization of materials in science texts in Transjordan is logical and systematic. It centers around substances and topics rather than around problem areas. The only criterion which guides selection of books is information. This criterion should be substituted by a number of criteria. These are:(1)

1. Selection and organization of content
2. Psychological plan of development of topics
3. The standing of the authers as sceintists or teachers of science

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(1) Heiss, op. cit., p. 66.

4. Supplementary materials and teaching aids.
5. Quality and selection of illustrations
6. Difficulty of vocabulary
7. Style
8. Mechanical makeup and endurability.

Another difficulty related to textbooks in Transjordan and the other Arab countries is terminology which is not agreed upon by translators. Valancy, for example, has four expressions in Arabic, which are:

The atom is called ذرة in Syria, and in Transjordan, Egypt, Palestine; the molecule, and ; the radical and .

This problem should be solved by agreement in a conference of members delgated by all Arab governments concerned. May be, this is an important problem to be solved by the Cultural Committee of the Arab League. The presence of different expressions for scientific terms in Arabic makes for confusion. Books published in one country are of no use in other countries. In case scientific magazines are to be published, their use is limited to the country in which they are issued. A Palestinian teacher taught science is Syria for two years. Then he went to Transjordan and was appointed to teach there. As he had studied science in English in this institution, the American University of Beirut, he became accustomed to use expressions of textbooks used in schools in Syria. After one week of discussion and lecturing, his students told him that they did not understand some of the terms he was using. This situation is aggravated by the lack of texts in the upper

secondary classes. A dictionary of scientific terms should be put by the Committee mentioned above. This is to be done by specialists in science-physics, chemistry, biology, astronomy, and geology - by language specialists. Periodical conferences should be held by these specialists, and translations of new terms should be added. This does not mean that we should invent irrelevent new terms in Arabic as it was done in translating the word "sandwitch" as

But on the contrary, we may adopt some terms as they are. The important point, here, is to have an agreement on what to use so as to universalize the medium of communication in scientific literature. The assistance of non-Arab scientists who speaks Arabic may be of value in this respect.

It is a good idea to have the members of the above mentioned committee collaborate in compiling scientific textbooks to be used in all Arab Countries. This will serve two ends. First, the collaboration of these specialists will produce a good quality of texts exceeding that of any individual effort, and second, this will make for the unification of the curriculum in the Arab Countries. This should not be misunderstood, because I do not believe in the supposed importance of the unification of the curriculum in establishing uniformity, and I do not recommend this uniformity because it makes for rigidity, sufficates initiative, and sacrifices local needs of communities. On the other hand

texts should be used only as tentative plans. This introduces us to the importance of the teacher in moulding the character and views of the learner as it is to be discussed later in this chapter.

Evaluation.

In the diagram on page 23, chapter II, the interrelation of objectives, curriculum, method, and evaluation was shown. Objectives are sought to be reached through a course - curriculum - which is to be in a certain direction - method. But how can we know that objectives are attained? The course may not lead to the goal. So the whole process is to be tested.

In Transjordan, we have daily, monthly, term, year, and stage examinations. The thing tested is the ability to reproduce acquired material. Each of the two stages of the ladder ends with a public examination. The school examination is not counted for promotion from the primary to the secondary stage. So a sifting operation is done through the public examination which is conducted by the Ministry of Education directly. Examinations conducted by inspectors are also designed to test information. Problems involving numbers are given in science but they can be called informational because they are from the text, which the student prepares in advance. Even in mathematics problems are sometimes memorized and solved from memory because of the restriction of teachers to problems from the text.

"Every thing that exists exists in some amount, and what exists in amount can be measured." This is Thorndike's thesis on which educational measurement rests. Measurement here is conceived of quanititatively as it is the case in the sciences. This thesis implies the existence of independent realities which are taken as standards, and measurement is a comparison among them. So the measurement of the educative process breaks it down into isolated processes which can be measured, namely,facts and skills. This leads to an emphais on these factors and the neglect of others as initiative,, and conduct. It also leads to verbalism and mechanizes the school.

What about the corollary of "What does not exist cannot be measured?" Education is concerned with potential development, so cannot we measure it? Judgment here differs from judgment of some thing complete. Education is dynamic and cannot be measured exactly because only static things can undergo that. Measurement cannot be done but to one variable in a system which the educational process is a whole, a total. This totality here is not a matter of addition and subtraction so as parts of it can be isolated, but it is a reconstruction of values, old and new, related to a goal. Hence, to test growth is to evaluate it. There is no final growth which can be evaluated as such. Growth is what leads to more growth and so it can only be evaluated when it is applied in a problematic situation of adjustment. It is to be related to further growth , a

reorganization of experience. But in what context is evaluation to beadministered? The individual is not the only entity in education. Social welfare is an aim; so evaluation should be in a life like situation, a social one, with consideration given to social welfare. Another thing is that the behavior of the individual outside the school should be counted.(1)

Another difficulty in educational measurement isthe problem of Units. Scientific units are constant. A centimeter is always a centimeter, but a grade is not always the same. If a person takes a seventy in a quiz and another seventy in another quiz, do these two seventies equal each other? The answer is negative, because one of these quizzes must be easier than the other. In the year 1941-42, all examinees in the Transjordan Matriculation examination passed it whiletwo years later only 18% passed.(2) What does this mean? Certainly it is the unreliability of the examinations. We cannot say that in one ear all students are above a certain line while in another only 18% of them are as such.

To evaluate learning in science we should test for change ~~in~~ in behavior rather than for information. Change in behavior in terms of objectives includes functional understanding, attitudes and thinking - use of facts. Steps in evaluation are to, 1) determine outcomes to be evaluated (sometimes specific as reading a thermometer), and 2) describe each outcome in terms of specific pupil behavior.

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(1) Dewey, J., Democracy and Education, p. 89-90.
Brubacher, op. cit., p. 268-74.

(2) Matthews, R., op. cit., p. 309.

The use of more than one method of testing is advisable.(1)

Evaluation had another important value besides checking, which is guidance of both pupil and teacher. The pupil is activated by being conscious of his progress which widens his interests and magnifies his effort to acheive his ends. The teacher also can find out points of strength and weakness in his method.(2) He can also diagnose difficulties of his students.

Teachers.

Well prepared science teachers are not available in Transjordan. The problem of procuring them still remains an unsolved problem for the Department of Education. As we neither have teacher training Colleges, nor a sufficient number of science bursaries to study in Universities abroad, it is not strange that a shortage of science teachers is to be confronted. Most Transjordanians who enter College have a craving to study for a career other than teaching. They want to be professional men, doctors, pharmacists, engineers, lawyers, and business men. Others, who do not follow these branches because of lack of interest or scholastic ability, follow the line of least resistance and study a social science for social prestige. This, most probably, is due to the low status of teachers in Transjordan both from the salary and prestige points of view. So to be a teacher is not a goal for ambitious educationally privileged

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(1) The Fourty Sixth Yearbook, op. cit., p. 106-110.
(2) Gile, op. cit., p. 305.

young men who can follow the other more remunerative careers with more social and financial output for less input of effort and time. Even those who happen to study science and teach as a temporary step, desert teaching afterwards to other departments in the government where they work less and have better opportunities for promotion.

A science teacher of Salt secondary school was expelled two months after the beginning of this academic year 1950-51. The Department of Education could not find another teacher to take his place. They were obliged to have the science teacher of the secondary school of Amman leave for Salt on certain days to give science lessons there. Professional qualifications are not found at all. The old concept of "He who knows can teach" is still in practice in Transjordan. This coincides with authoritative educational theory. But if we are to look for the fulfillment of the objecttives which go beyond information, objectives which develop functional understanding in the pupil, methods of problem solving, and attitudes, we face an urgent need for will trained teachers who understand three things; their subjects, the learner, and the way to help him learn. The teacher who is to prepare a proper atmosphere, who will stimulate the learner to follow desirable responess from his own accord, should know the learner himself. Also, he who is going to execute something should know its value and the philospphy behind it. This will illuminate his way and make the educative process consistent.

The teacher is enormously important in the progressive philosophy and practice of education. He is to be an excellent guide, communicating those who are guided through a course and a direction

which he knows, to a destination known by all. Respect of the interest of the child makes it important to have a flexible curriculum and method. The teacher is responsible for this flexibility. H e also should direct interest for individual development and social welfare. Attitudes can not be taught through preaching. It is the personality of the teacher and the manner in which he behaves which is most impressing.

To solve the problem of science teachers in Transjordan, training colleges should be founded. A sufficient number of hursaries should be sent abroad to study science and education. Salaries of teachers should be raided and should exceed salaries of equals now in other departments because teachers exceed them in the effort and time they spend in their work.

The teacher is the corner stone in education. We should begin our reform with qualified teachers.

CHAPTER FIVE

SUMMARY AND RECOMMENDATIONS

Summary.

From the foregoing presentation and analysis, we see that education in Transjordan is traditional in nature. It was borrowed imitatively without a real understanding of its meaning or function. Social progress and welfare with individual development are neither manifested in its aim nor in its operation. The production of an Arab nationalist living as a civilized man gives, according to authorities in Transjordan, a comprehensive idea of the whole process of education both in essence and practice. A vague aim leads to confusion. We dare say that it is not an aim but a rationalization of what is done. A civilized man knows certain things, so our youth should know it. Whether the needs of that civilized man differ from ours, due to difference of the community or not, is not taken into consideration. Information and facts are considered as the only conceivable means to attain that end. The curriculum is loaded with facts to be acquired. Subject matter is determined by official committees. The learner does not participate in any way in determining it. He is to fit himself to subject matter in the easiest way by mastering text material passively.

Education in Transjordan is authoritative in aim, subject matter, method, and evaluation. It is authoritative in aim because

the pupil does not share interest in it. Singnificance of the aim of the process is not shown to the learner to have a share in being interested in it. It is imposed on him,or in other words, it is not recognized by him. It is determined by '' those who know '' as is the case in a dictatorship. What I mean by a dictatorship here is not the political meaning, but any kind of imposition of ends. Subject matter is authoritative in the samee that the learner does not participate in the laying down of it. This does not mean that the teacher should ask the child what to be taught,but it implies the respect to the learner so as to have subject matter directly related to his needs, present and future. The teacher should make the learner adopt the desirable subject matter in the process of his development. This situatin calls for well trained teachers and flexible curricula. It is imposed even on the teachers. Method is authoritative in the sense that it does not start with the interest of the learner the systematic organization shows that. The whole process including its results,is not evaluated for showing the student his progress or diagnosing his difficulties; but its sole purpose is to decide on his qualifications for promotion, or elimination.

Phylosophical Discussion.

Life is an active process which aims at meeting the biological , emotionel ans social, needs of the individual. These needs are interrelated. Biological needs are basic and should be met inorder to preserve the life of the individual. An ill fed child will die.

But a well fed child, whose biological needs are met, but who does not receive the affection and love of his parents - lacking emotional security - might deteriorate physically or at least his physical development might not be as it would, had emotional security been provided. A new born child associates the satisfaction of the hunger drive with his mother or nurse. Even though the satisfaction of his biological needs restores equilibirium, and gives a feeling of satisfaction, still, if his mother or nurse does not give him the affection and love that go with the feeding experience, some thing will be lacking. Besides the role of parents or nurse, intelligence assumes its sole which progressively increases with age. It becomes a major factor in his finding the best and most economical techniques that will satisfy both his biological and emotional needs. He cries when he feels hungry or afraid. This is a simple mechanisms of adjustment.

This discussion does not mean that the bioligical, emotional and intellectual factors are separable. Also physical security is not static. On the contrary, so many things may be conditioned by it that it may seem absent. Someone may undergo a mental break down due to the loss of a dear person while his physical security is not touched directly. The separation is just for analytical purposes. The personality is a dynamic whole; an integration of the physical, emotional, and intellectual factors. These three integrated factors should be found in a harmonious relationship so as to make for the growth and development of a mature individual

with an integrated personality which is capable of adjusting to, and of meeting novel situations.

A philosophy of life should be based on the meaning of life. This is important for discarding abstractness and attaining practicality. The philosophy which should guide our actions should rest on this life factor - security and satisfaction of needs. The aim of education should stem from this need for security. The individual is more secure when his abilities and capacities are developed to their utmost, and his potentialities capitalized and recruited to his well being. But how can that be done? It can be done through education. The individual is guided by the teacher through the right channels to reach his end.- growth - through his own activities with the least shortcomings and time. But how can the individual use his capacities to reach his ends? Can he do that individually in isolation? The modern life of specialization interrelates the needs of individuals through its extensive branching and narrow specialization. Relative individual independence of the primitive man is substituted by thehigh interdependence of the modern civilized technical man who is limited to one job or industry or even a minute division of it. This interdependence is extended from individuals to nations who are interdependente on one another and should cooperate for the happiness and well being of their members. So the frame of individual development for individual security is social. Social development through coordination of the development of individuals for their collective well-being is the desirable setting and background for the development of the individual.

The interest of the individual is inseparable from the interest of his group, and so social interdependence necessitates maximum cooperation of all individuals.

How can science teaching contribute to this general aim? The objectives of science teaching center around functional understanding of facts, concepts and principles, problem solving, and attitudes.

Man was all the time feeling insecure regarding natural phenomena and forces. He feared both these phenomena and was curious about them. So, he attributed them to the supernatural. But now, through science, he understands and interprets them. By so doing, he has developed a belief in himself and attained confidence in his knowledge. Then, he stepped further and controlled his natural environment to attain security and satisfaction. Scientific method and thinking give practicality and objectivity to man. He tackles his problems with an attitude of tolerance which facilitates his liberation from dogmatism, thus leading him to progress.

The concrete science material used in the education of the child should be determined and organized in accordance with an aim, which must in the last analysis, lead to the development of the individual. This development should take place in, and contribute to, a social setting which ensures social coordination and progress. This necessitates materials centering around the following interrelated topics:

1. A philosophy of life
2. Health - individual and public,
3. Food, its values and production, clothing, shelter
4. Vocations

5. Family life and adjustment
6. Understanding the physical and social environment.

These six points have a social orientation as well as an individual emphasis. The social implies the moral. This should be well manifested in the social life of the school. A democratic school government which implies sharing of interest of students and teachers, participation in planning, and cooperation in action for collective ends, should prevail. This can be applied in Transjordan in student councils for schools, elected by the student body. Various committees are also of use for the active participation of the maximum number of the students.

Science is the major foundation of the second, third, and partly the fourth, fifth, and sixth points mentioned above. Health, food - its preservation and production - and material necessities of life are subjects of science. Most vocations are also subjects of sciene. Most vocations are also subjects of science. This is very clear in industry and agriculture. Subjects, other than scince, are better dealth with in a scientific method and attitudes of suspended judgment, and open and critical mindedness. Family life and adjustment depends among other factors, on sexual adjustment and satisfaction. This depends also on previous sex education both from the points fo fiew of facts and attitudes. Science is the sole foundation of the first part of the sixth point, that is, understanding the physical environment.

The development of the individual should be dynamic and direct. This necessitates two things: it should begin with his interest and should be carried out actively. Activity is necessary in every real situation. It is also necessary for checking and application of judgment. This will bring out his security as a conscious manifestation of his actions and so motivates him for further activity to reach his goal. This also makes for a real developed personality, an experienced one. It brings up a coordinated personality with no lag of action and experience to advancement in information - if we can call it an advancement. Science, with its practical nature, makes a good subject of this aspect. The way in which science should be taught, problem solving, contributes to active knowledge which is used further in the solution of other problems emerging in the future. The sensible results which are attained create new interests in new situations and problems. The way problems are attacked with the use of all attainable data makes for an integration of experience and an understanding of interrelated factors in a situation. It also makes for comprehension and thoroughness which are needed for harmony in thinking and behavior.

Practical Design.

Centralization of the interna of the system of education in Transjordan in all its aspects makes for standardization and authoritativeness. The Ministry of Education defines the aims, lays the curriculum and determines the method by its public examinations which center around information only, thus reducing method to mere acquisition of information. This situation would not be improved

even if schools were given the liberty to manage these affairs because of the lack of well trained teachers. The teacher is the corner stone in the formal educative process; because its efficiency depends on his insight and functional understanding of his job. He should understand the general aim of education and the objectives of his subject matter. He should understand his subject matter as well as the growing child. He assists the learner to realize the importance of the aim and objectives of education for his well being. This is a very difficult job which can be entrusted only to trained teachers. To make the learner see that what is required is important calls for knowledge of the nature of the learner and training in the right way of motivation. The teacher also gives the learner the the opportunity to participate actively in laying down the curriculum. The choice of abiding interests which are found in the present and continue in the furture are favoured indirectly by the atmosphere the teacher creates. The way he evaluates success and development gives the learner the meaning of what he is doing and an indication of what he should emphasize and exert more effort upon. This evaluation is also a reforming process to correct mistakes in method. Another important responsibility of the teache is the encouragement of the internal building of desirable attitudes and modes of conduct. This is best done through motivation and demonstration. The suitable atmosphere should be created in order that the student behaves well from his own accord. Possibilities of bad behavior should be avoided.

Prevention should precede cure. The personality of the teacher is a model for his students. His way of speech, dress, punctuality, and behavior are parts of the desirable atmosphere and environment. So we should begin with him in order to attain our aim in education. He also will make for the decentralization of the system because we will be confident in his ability to understand the local situation better than those officers in the Ministry of Education. Training colleges are the first thing which should be done. These should be founded, and specialists should be borrowed from other countries for their temporary management. Bursary students should be sent abroad tostudy special subjects and education to come back and gradually take the place of borrowed specialists. Students enrolled in these teacher training colleges should specialize in a field of knowledge and not in single special subjects. Sciance, in its all branches, should be taught in these colleges. This includes physics, chemistry, biology, astronomy, geology, and physiography. The status of teachers should become high and attractive by raising their salaries to insure for them a decent living.

This project has a difficult obstacle to overcome. From where can we get the money for it? The budget of the Department of Education is deficient for the initiation of such a project. The general treasury is deficient also. Authorities in Transjordan do not differntiate between the important and the more i important. Such educational projects are far more important to the well-being of the community than the foundation of a legation in Afghanistan. The point is that we are dominated with superficiality and megalomania. Whatever we do is to give an

attractive external appearance while we are not sound and solid in the internal - in relation to vital aspects of life. The governement encourages the importation of cars but not of tractors. Our salvation is in a sound economic system which would provide the money necessary for social health and educational enterprises. Anyhow, this process should be begun quickly and the money should be saved for the time being by eliminating other less important projects.

Beofre leaving finance aside, I should point out the necessity for opening hostels on the government's account for bright students from villages where there are schools of four grades only. Their bad situation is not only of inequality of educational opportunity, but the village usually provides the building of the school, while the government provides it in the city. Another thing it, that students in villages cannot continue their education after the fourth primary. Hence, their potentialities are not developed. They are deprived of their right of continuing their education and so they lose, and the community loses their talents. The number of schools should also be increased so as to secure equality of educational opportunity for all children. Compulsory education for the elementary years - the first five primary years - is merely black on white; and that is because of lack of schools. Government schools do not accept students who come to enter the first year primary of their own accord. The comulsory

age should gradually be extended to the seventh primary year at least, and should be strictly executed.

Our crucial problem now, in Transjordan and in the East in general is to catch up with Western civilization. We are adopting western civilization, but superficially. We take the Western life from its external aspect - cars, woollen goods, and the like. These are fruits of the tree of science, industry, but grown outside. We consume goods and use luxurious materials imported from the west. There is no balance between our imports and exports. The result is a lame system of economy which destroys the country and makes it poor and weak. The salvation is in industrialization. This industrialization will make us economically independent. It will make for the production of what we consume. This does not mean that we will have an excess in some kinds of production which will balance the deficiency in other kinds. We have potential industries of phosphates fertilizers, leather, woollen goods, dairy products, agricultural industries, and others. These need two things, first, sound economic planning, and second, well trained specialists and technicians. The first, sound economic planning, is irrelevent to our discussion, but the second is one of the fruits of science teaching. The production of specialists, and technicians in science, mechanical, electrical, chemical, and agricultural engineers, is greatly needed. This task necessitates two acts: first, the revision of science teaching in acadamic schools; and, second, the

foundation ofna sufficient number of technical schools. Science is not given its due importance in the elementary program. Only two periods a week are devoted to science out of an average of 31 periods a week as is shown in table 2. Religion occupies double the periods of science; English at least three times, The schedule should be rearranged. Religion is mostly the business of the home and of religious institutions. Another thing is the presence of two religions, Islam and Christianity, in Transjordan. Some advocate the stress or the teaching of religion for moral purposes. This, to my thinking, is not a strong point because morality should be built from within, that is self built morality. The child acquires a moral and social conduct, not through preaching, but through being found in a suitable environment in the school, at home, and in society. Situations which may develop bad conduct should be avoided. The individual acquires the best conduct by being in the best system of life.

English is begun with in the fourth primary grade. Its use is greatly suspected in the primary stage especially in the fourth and fifth grades. Most students do not continue their study after the primary stage and even the fourth or fifth primary grades and so English is of little use in their life out of school. Another thing is that priority should be given to more important subjects which are of abiding use. So, periods of religious instruction should be renduced at least to one half their number. English should not be taught at the cost of other subjects. Science should be given its due share of periods a week. It should be at least equalized with language in

this respect.

Laboratories should be supplied with materials and equipment so that students should have the opportunity of doing individual laboratory work. The classwork of science should be held in the laboratory so as to make it possible for demonstrating and experimenting even during a discussion period, if it is found to be necessary. Objectives, curriculum, method, organization and evaluation should follow the suggestions posted in the second, thrid, and fourth chapters.

Agricultural, mechanical, and electrical technical schools should be opened. As our country is agricultural, the easiest and the first step should be opening agricultural schools which should combine both the practical and theoretcial. These schools should be given priority to other industrial schools. Agricultural industry should be the first steip in industrialization. Schools should be located in agricultural areas and not in cities. They should conduct research work and experiments to improve crops by selecting seeds, finding better ways of cultivation, and fighting pests. These schools should serve a double aim. They should train students in agriculture, and better the conditions of the area in which they are. Communities should benefit from the school by seeking its advice. The school should also aim at solving agricultural problems of the community. Other technical schools should aim at ~~xxxxxx xxxxxxxxxxx~~ vocational training and civic service.

The second aspect of the problem of catching up with western civilization is that of the cultural lag. Although science applied in industry made for a change in the social system, this latter is still lagging behind the scientific industrial advancement. This lag is found in the west in a way that social life, ideals, traditions did not accompany science in its advancement. Means changed quicker than ends. The old ways of thinking, in connection with social and moral matters, did not change much. This lag is intensified here in the East. We adopted the material fruits of science without adopting its ways of application. This brought out a great difference between our old ways of conduct, our traditions, and the new mode of life. The clash is now very hot due to the dogmatism of the old. This is due to ignorance. It is still transmitted to the new generation. The education which the younger generation receives is mostly verbal. This practice does not conform with education in its real sense which, to my mind, should liberate the mind and make for free thinking before anything else. The only thing the students get of what they call education is information. The role of science in the solution of this situation is all important. The use of scientific methods and attitudes of objectivity, suspeneded judgment, and open and critical mindedness makes for its transfer in solving other problems including social problems. Objective scientific facts which contradict prevailing beliefs and superstitions give a clue, a starting point to a critical attitude towards every thing of social use which should justify it s application in terms of use for desirable ends. Science steps here to contribute some factors to a sound philosophy of life. In short, the effect of science is that it makes for flexibility in this ever changing world.

APPENDIX

A letter from science inspector.

Irbid, 15.3.1951.

Dear Mr. Nabulsi,

I received your letter dated 7,3,51. I shall answer your questions as I can.

Science teaching, like other fields, has a definite program for the attainment of definite objectives. When we speak of the syllabus, we must mention the stages of the ladder in relation to objectives, and age of the student and his ability. The school years are divided into three stages:

1. The first stages is the elementary stage which consists of five years. The age for this stage is from seven to twelve. The aim of this stage is literacy and a general education fitting them for good citizenship. This stage is compulsory.

2. The second stage or the intermediate stage which includes the sixth and seventh primary, and the first and second secondary. It is intended to make it three years in the future under the name of the intermediate secondary school. The age for this stage is from the twelfth to the fifteenth or sexteenth. The goal of this stage is:

   A. Preperation for the upper secondary stage.
   B. Preparation for elementary agricultural schools, elementary teacher training schools, industrial commercial, and technical schools. Compulsory education should be extended to the end of this stage in the future when the budget of the government and circumstances permit.

3. The third stage or the upper secondary stage which consists of two years and it is intended to make it three. The age for this stage is from fifteen to eighteen. The goal of this stage is preparation for university entrance and specialization.

We can divide the first stage into two division, the first consisting of the first three grades and the second of the following

two, fourth and fifth. It is intended to integrate the science lessons of the first division with hisory and geography so as to make a practical course depending on experiences in life, and it is to be called "Knowledge," or "Knowledge of life." But now we have different seperate courses for all these subjects.

We ask the teacher of the first grades to make the lesson a part from the daily life of the pupil. It should include real situations of what he sees and experiences in his environment. For example, when "animals at home," are discussed, the discussion should be as follows:

A. Our cat: the kinds of cats according to their size and colour, how do they play, how does their mother watch them, health and cleanness of our cat, how does the cat respond to mice and birds? What do we feed our cat.

B. Our dog: What does our dog od in the day? What can the dog do? The kinds of dogs - as the observations of the children indicate.

This is an example of a lesson. We aim from it at:

1. To develop appreciation of nature
2. To develop keenness of observation
3. To arouse curiosity and to use experimentation to satisfy it
4. To get practical desirable results of daily life observations
5. To induct rules of health from the life of the child and the community.
6. Social use of these obtained rules.

In the second division of the first stage, that is in the fourth and fifth grades, subjects are classified and systematized in relation to the mental development of the student. He is given nutrition, clothes, shelter, means of illumination and heating...etc. The teacher uses charts and some machines and materials which he gets from his environment and which may be found in the school.

In the second stage, that, is, the sixth and seventh primary, and the first and second secondary, the student is given elementary chemistry and elementary physics in addition to "object lessons," so as to be able to enter industrial, commercial, agricultural, or higher secondary schools. Here, we ask teachers to make their lessons as practical as possible. The Department of Education supplies schools with equipment and materials. Teachers are also asked to use materials obtainable from their environment as a bottle, a ruler, samples of plants, samples of animals, bones of animals, etc.

Students are asked to take notes of what they observe and of the results of their experimentation and to pass these notes to the teacher to give his directions.

In the upper cycle of the secondary school, where the student is prepared for university entrance, we provide schools with all materials and equipment necessary for the learning of physics and chemistry. The students apply their practical lessons under the supervision of the specialized teacher. They take down results in copybooks. We aim from these practical lessons to habituate the student care and exactness in work and to conclude results as near as possible from the real answer. We prefer a less number of exact and well done experiments to a large disorderly number of it not cared for its results. To cultivate the inclination for practical scientific, research, exactness, persistance, and correct scientific inference are the objectives of science teaching in the secondary years.

Speaking of the overloadedness of the syllabus, as it was mentioned in our fourth question, it does not mean its vastness. There are many topics which are put to be mentioned as topics studied in earlier years which seem necessary to be a bridge to the new material which is to be discussed fully.

It is known to you, however, that syllabi of governments are put by official committees supervised by higher authorities. And being a member of these committees, I may have opinions and theories differing completely from the syllabus in practice. We move gradually and in accordance with circumstances to complete our syllabus and make it perfect.

I hope my ~~zanad~~ concise answeres to your questions are satisfactory. I am ready to answer any question your ask in the future in this respect.

With my greetings,

Inspector of Science Teaching,

The Hashimite Kingdom of the Jordan,

THE SYLLABI OF OBJECT LESSONS, HEALTH, AND AGRICULTURE FOR THE PRIMARY GRADES

1. Object Lessons and Health.

The First Grade.

Domestic animals as the dog and the cat, and poultry birds as the hen and the pigeon.

Some plants, trees, herbs, and weeds.

The necessity of washing the face and the head every morning, cleanness of the mouth and teeth, cutting the nails, the injury of putting the fingers in the mouth and the nose, the necessity of washing the hands before and after meals, care of the eye and the benefit of washing it and precaution from flies..

The necessity of killing mosquitoes, flies, and lice.

The Second Grade.

Domesticated Animals: the sheep, the goat, the cow, the camel, the horse, the donkey, and the rabbit.

Poultry, the duck, and the gouse.

Description, habits, benefits, and food.

The fish.

Wild animals found in Transjordan: the wolf, the fox, the hyena, the snake, and the deer.

Wild birds: the sparrow, the owl, and wild pigeon.

Principal parts of plants: the root, the stem, the branches, the leaves, and the flowers, with their functions in general.

Good looking in dress, housing and other deeds. Sitting straight

drinking water, the harm of wat clothes, playing in the open air, regular time of going to bed, early sleep and early awakening.

The third grade.

Living and nonliving things around us. Plants: growth, nutrition, reproduction, flowers and how to take care of them.

Animals: different animals that we know, comperison in food, shelter, growth and reproduction.

Nonliving things: rocks, soil, water, and metals.

Plant foods: vegetables, and fruits and their benefits. The necessity of washing them.

Animal foods: milk, eggs, meat, and butter.

Common salt and its benefits: water, importance of water to life, drinking water, purification of water.

The importante parts of the body, sweat and the benefits of bathing, and care of the eye, hte nose and the ear.

Time of sleep and its duration: the head, the mastress, and the blanket, the danger of making gire in sleeping rooms.

The fourth grade.

Animals, plants, and non-living things: vertebrates, mammals, their benefits, the higher species, man and the monkey, insect eating animals, plant eating animals.

Birds: prey birds, the sparrow, swimming birds.

digestion: healthy rules of eating, etiquate pf eating, blood, circulation, air, and respiration.

First aid: wounds and bleeding.

The fifth grade.

Reptiles, amphibians, fishes.

Insects, worms, sponges.

The skeleton, mustles, its kinds and function.

The nervous system, the five senses and their organs.

Eye diseases, skin and the urinary system.

Spourts, its rules, cleanness of the body,

Bacteria and microbs.

Contagious diseases transmitted through food, water, and air.

Malaria, mosquitoes.

Smallpox, typhoid, rabies.

Chice of the house, and arranging first aid.

2. Elementary Science.

The sixth grade.

states of matter, important specific and general properties of matter.

Attraction of the earth to a body, its wieght, its mass, its volume and how to measure it, specific weight.

Liquid pressure, level of a liquid in connected pipes, springs,

Law of Archamedes.

Sinking and floating bodies, ships and submarines.

Air pressure: amount and measurement, the barometer.
The pump, the baloon, the effect of the rise from see level on the human body.
Sources of heat: temperature, expansion of bodies on heating, measurement of temperature, mercury thermometer, the centigrade scale.
Temperature of the human body, evaporation, cooling as a result of evaporation, sweat and its effect in high temperature, boiling, purification by boiling, melting, freezing of water, heat conduction, ventilation and heating, wind, clouds, rain, dew, ice, clothes in Winter and Summer, harm of tight clothes, ciculation.
The lever, benefit, law, levers in the human body.

The Seventh Grade.

Elements, compounds, mixtures.
Difference between chemical and physical changes, properties of sulferic and hydrochloric acids.
Digesive system: teeth, the mouth, the stomach, the intesines, the liver, and the place and the function of each.
Rust, impotant properties of oxygen, combustion and its resultants, composition of water, properties of hydrogen, properties of nitrogen.
Aid and its constituents.
Properties of carbon, charcoal, diamond, preperation of calcium oxide and its properties.
Respiration, its mechanism and benefits.

Nutrition, benefits of different kinds of food as meat, fish, eggs, bread, and vegetables.

Milk, its kinds, pasturization, foods extracted from milk.

Skin, and the kidneys and their function - in some detail.

Magnetism and the magnetic needle.

Electrification, lightening, thunder, thunderbolt, the electric cell.

The magnetic effect of current, the electric bell, the electric lamp.

Sound: its occurance and transmission, its speed, the echo, the ear, the larynx, the speed of light, reflection, the plane mirror, deflection of light, the eye and sight, illumination on writing and reading, the benefit of sunshine in killing microbes.

Eye diseases, alcoholic drinks, tobacco and coffee, and the harm of their use, microbes, parasites, malaria, the mosquito, its stages and kinds, protection from malaria, how are the following diseases spread and the way to avoid their spread; typhoid, smallpox, typhos, plague, rabies, tuberculosis, inoculation, first aid, fainting, artificial respiration, suffocation, wounds, snake bite, etc....

THE SCIENCE SYLLABI FOR SECONDARY CLASSES

I. Physics.

The First Year

Properties of Matter: Metric measurements, weight, mass, force and its measuremth, density, specific weight, states of matter, molecular theory, the law of conservation of mass.

Liquids: Liquid surface, pressure, Pascal's law, water distributim in cities, artesian wells, Archimedes law, floating bodies, density measures, hydrometers.

Gases: Pressure, atmospheric pressure, the barometer, Boyle's law, pumps.

Heat: Sources, expansion, heat and temprature, thermometers, coeficiant of elongation, Charle's and Gay Lussacs laws, specific heat, evaporation, boiling, boiling point, melting, freezing, conduction of heat.

Sound: Source, conduction, sound waves, speed, echo, vibration.

The Second Year

Mechanics: Force, resultant, center of gravity, speed and velocity acceleration, laws of motion, falling bodies, moentum, law of gravity, work and energy, friction, lever , pulley, inclineds surface .

Magnetism: Natural and artificial, poles, attraction and repulsion magnetic needle, magnetization, saturation, loss of magnetism theory of magnetic particles, the magnetic field, earth magnetism, compass.

Static Electricity: electrification, conduction, isolation, the

the electroscope, distribution of charge, atmospheric electricty and its prigin, lightening, thunder, electrical discharge.

Dynamic Electricity: The current, galvanoscppe, polarization Daniel's cell, the dry cell, electric battries, resitance , Ohm's law, magnetic effect and field of currents, coils, and the electric magnet, electric bell, telegraph, dynamo, microphone , heat effect of current, simple lamp.

Light: Source, transmission, transparent bodies, the image, eclipse, speed, wave, reflection, mirros, deflection and effect on sunshine and sun set,mirage, the eye, short and long sightendnes s anaylsis and synthesis, of light the camera, microscope.

The Third Year

Heat: Temperature and measurement, expansion, gas law, specific heat, mechanical, equivalent of heat, heat as a kind of energy latent heat, vapor pressure, evaporation, boiling, humidity .

Light: Transmition, wave theory, speed, colours, mirrors, dispersion, lenses, lights, as a kind of energy.

Sound: Transmition, waves, speed, vibration, musical ladder.

The Fourth Year

Mechanics: Measures, density, specific, weight, levers, center of gravity, force, work, friction, falling, bodies, gravity, centrifugal force.

Magnetism: Properties, magnitization, earth magnetism

Electricity: Static electricity, electroscope, dynamic elecricity, electrons and ions, transmission, heat, chemical reactions, magnetism as result of electric current, galvanometer, Ohm, Jule, and Faraday laws, electric magnetism, electric magnetic waves, radio waves.

2. Chemistry.

The First Year

States of matter, physical and chemical changes, elements, compounds, mixtures, symbols.

Solubility,

Solutions, saturation, supersaturation, undersaturation.

Suspension, filtration, evaporation, distillation, crystalization, sublimation,

Air and its constituents, air a mixture,

Oxygen, preparation, properties and uses

Combustion, flame, oxidation, rust,

Hydrogen, preparation, properties, uses, reduction,

Water, composition by weight and volume, kinds of waters, purification of drinking water

Nitrogen, sources, properties, preparation and uses.

Carbon, kinds, properties, oxides and their preparation

Metals and nonmetals and their ~~preparation~~ oxidation.

Acids, bases and salts.

The Second Year

Symbols, atomic weight, molecular theory, molecular weight

Laws of chemical combination.

Gas laws (Boyle, Charles, Gay Lussac)

Equations and calculations based on them.

Daltons law and the new atomic theory.

Metals and nonmetals.

Chlornine, preparations, properties, compounds, sulfer, kinds, and preparation, compounds, phosphorous, sources, kinds, preparation, compounds.

Soduim, sources, preparation, properties, uses, compounds.

Calcium, " , " , " , " , " .

Zink , " , " , " , " , " .

The Third Year

States of matter, physical and chemical changes, elements, compounds, mixtures, solubility, solutions.

Franctional distillation, water of crystalization, efflorescence, opplescence, sublimation, hydrolysis.

The atom, Dalton's law, Avogadro's law, atomic theory.

Laws of chemical combination,

Gas laws

Symbols and equations

Oxides, oxidation, reduction.

Molar, normal and molal solutions, indicators.

Kinds of chemical reactions, catalysis.

Study of the following elements and their important compounds:

H_2 , Na, K, Cu, Mg, Ca, Zn, Hg, Al.

The Fourth Year

The study of the following elements and important compounds:

F, Cl, Br, Id, O_2, S, N_2, Ph, As, C, ~~cilisium~~, lead (Pb), Fe.

Ionic theory, electrical analysis, Faraday's law,

Organic chemistry.

Saturated and unsaturated hydrocarbons.

Alcohols

Aldehydes

Acids

Esters,

Carbohydrates starch, cellulose.

Fats, glycerine, soap.

Aminoacids, benzine ring, phenols, dyes.

3.Botany.

The First Year.

Definition and importance of botany.

The cell; composition, function, and divisions.

Principle plant parts

A. Definition, composition, growth, functions, and kinds of roots, stems, leaves, and flowers.

B. Definition, functions, and way of propagation of fruits and seeds.

Plant nutrition

A. Definition and sources

B. Nutrition sucking and chlorophyl

C. Respiration, growth, and carbonic and nitroginic cycles.

The Third Year

The plant cell, composition, functions, divisions, and reproduction.

Algæ, in some detail.

Fungi, " " "

The root, composition, growth, and kinds.

The stem, anatomy and growth.

Buds, classification, and anatomy.

The leaf, anatomy, arrangement, coloration, and fallof leaves,

The flower, anatomy, form and arrangement of parts, Fertilization, and formation of seeds.

Fruits, Formation, and composition.

Seeds, formation, composition, and spread.

The Fourth Year.

Growth in detail.

Functions of roots, fixation, sucking, and transportation.

Functions of stems, bearing of leaves, conducting water, and row materials to the leaves,

Functions of leaves.

Tropism

4. Zoology.

The Second Year

The animal cell, constituents, functions, and direct division.

Comparison with the plant cell.

Unicellular animals.

Multicellular animals up to insects.

Fishes, (pisces)

Amphibians

Reptibles

Aves

Mammals (rabbit)

a. circulation

b. digestion

The Third Year

Unicellular animals.

Sponges

Multicellular: jellyfish, platyhelminthes, nematoda, arthropoda.

Mollusca

Echinodermata

The Fourth Year

Vertebrata:

Amphioxus

Fishes

Amphibians; the frog

Reptiles

Aves; hen, pigeon

Mammals; rabbit

Social life in the animal kingdom; bees

A LESSON PLAN (1)

GENERAL TOPIC - HEAT

Sub-topic - Distribution of heat by convection.

Lesson unit - Uses and control of heat in the home.

Lesson problem - How to start a fire without getting smoke into the house.

1. A. General preparation.

   a. What does heat do for us? (Uses.)

      1. It keeps us warm. Generalization - It is necessary to all life, animal and vegetable. (Physiological.)
      2. It cooks our food. Generalization - It is essential to a multitude of industrial processes (blacksmithing tinsmithing, making glass, bricks, and pottery, metal working, etc.). (Industrial.)
      3. It runs our steam engines and automobiles, and gives us our electric lights. Generalization - It is the source of our mechanical power and artificial light. (Industrial.)
      4. The sun's heat causes winds and ocean currents which distribute water vapor and heat over the earth. (Physiographic.)

   b. From what sources do we get it? (Sources.)

      1. Wood, coal, peat, oil, gasoline, natural and artificial gas. (Fuels. Combustion.)

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(1) Twiss, G., A textbook in the Principles of Science Teaching. P.55-8

2. Friction, impact, abrasion. (Mechanical Work.)

3. Sunshine.

4. Animal and vegetable life processes produce it.

5. It comes from volcanoes, hot springs, and geysers. (Vulcanism.)

Generalization - Our sources of heat are, - burning fuels, mechanical action, living organisms, the interior of the earth, and the sun.

c. How does it travel? (Transference.)

1. Along or through metals. (Conduction.

2. Through space, from the sun, stoves, radiators, etc. (Radiation.)

3. By means of currents of air or water. (Convection.)

Generalization, - Heat is transferred from place to place by three processes, called respectively, conduction, radiation, and convection.

d. Why must heat be controlled? (CONTROL - NECESSITY OF.)

1. To prevent conflagrations.

2. To prevent smoke and dirt.

3. For convenience in use.

e. How do we control it? (CONTROL - MEANS.)

1. The means of control are fireplaces, stoves, and furnaces, with their chimneys.

2. The essential factors of these appliances are a grate to support the burning fuel, a fire pot to confine the fire, a chimney to conduct away the smoke and gaseous products of the combustion,

an ash pit to receive the solid products of the combustion, and one or more dampers to regulate the "draft."

3. General principle: In all apparatus for the use of heat there must be means of maintaining free circulation of air through the burning fuel. And if the material to be heated is not to be placed directly in the fire, there must be means of transferring the heat to the places where it is wanted.

I. B. Statement of the aim. The lesson problem.

What is the best way of building a fire in your grate, stove, or furnace, in order to avoid smoke, dirt, and trouble?

II. A. Specific preparation.

a. Materials: matches, shavings or paper, fine kindling, coarse kindling, small lumps of coal.

b. Method of laying the fire. - First, see that the chimney and all the flues of the apparatus are clean, that the space under the grate is clear of ashes, and that all dampers are arranged for the free draft. Then build up the materials in the order named, beginning with the shavings and ending with the coal, taking acre that it be piled loosely, so as to leave a lot of "little chimneys" through which air and flames can come up and get into contact with all parts of the fuel. Apply the lighted match or paper to the shavings at the bottom.

For the grate, put on the "blower"; for stove or furnace close all openings into the chimney above the fire and leave the draft-door open below the grate. When the first coal is well started, add more, cautiously.

c. Principles to be abstracted from concrete experiences with fuels, fires, and heating apparatus. (COMBUSTION - PRINCIPLES.)

1. Fuels burn only when they have been heated to their kindling temperatures, which a re different for different substances, but always the same for the sam for the same substance.

2. The kindling temperature of coal is relatively high hence very hot flames from the kindling must be made to circulate rapidly through it.

3. For this purpose the kindling must be burnt rapidly with a rapid circulation of air. (See I. A. c. 3.)

II. B. Reflection.

In the early fall, when the air is not very cold, it often happens when building a fire that the smoke refuses to go up the chimney, but pours out into the house. Here is a problematic situation the solving of which requires a general princip To discover the principle in accordance with which we can so keep conditions that the smoke must go up the chimney instead of down, anal sis, synthesis, and inductive interference are necessary. The cause of the move ent must be discovered.

a. Suggestions likely to be offered as to the cause of the phenomenon.

1. "Hot air rises."

2. The chimney "draws," or "pulls."

3. There is a "circulation."

4. "Something must push the smoke up."

b. Examination of these suggestions in the light of the facts.

1. Experiment with an exhausted flask on a balance, to show that hot air falls. Hence this is useless as a general principle. It is also useless because it tells nothing as to a possible cause.

2. Since the different portions of a gas have no tendency to cling together these terms are absurd in connection with this case.

3. This statement affords us a brief description of what occurs. But what causes the circulation?

4. This is a fruitful suggestion, to be developed by comparison of the air in the chimney with balloons in air, and corks, air bubbles, etc., in water. Recal the principles of equilibrium in fluids from previous study of mechanics (principles of Archimedes and Pascal).

III. A. Hypothesis.

The air inside the chimney may be lighter than an equal column of air outside, which because of its greater pressure would flow under the lighter air and push it up.

III. B. Developing and testing the hypothesis.

a. How may the air inside become lighter?

1. By expanding and overflowing at the top.

2. Experiment with an air thermometer to show that air is expanded by heating it.

b. Experiment with two connected lamp chimneys, kept at different temperatures, to show that cold air descends and displaces the warmer air. Direction of air current marked by smoke from a "joss stick."

c. Similar experiment with convection tube filled with water. Direction of current marked with scrapings of blotting pape

IV. Conclusion. Statement of the general principle of convection currents in fluids.

V. A. Applications.

a. Tall chimneys, straight flues, dampers, chimney caps, etc. and their influence on the draft.

b. Cooking ranges, - their construction and management.

c. Construction and management of hot air heating apparatus.

d. Construction and management of hot water heating apparatus.

e. Ventilation systems (of the homes and the school particularly).

V. B. Making an outline of the organized subject matter.

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احاديث مع مدرسي العلوم في عدد من المدارس

امارة شرق الاردن ، وزارة المعارف ، نظام المعارف رقم (١) لسنة ١٩٤٥ ٠ نظام المدارس الخصوصية ٠

حديث خاص مع وكيل وزارة المعارف، شباط سنة ١٩٥١ ٠

كتاب خاص من مفتش العلوم في المملكة الاردنية الهاشمية، الملحق ٠

ملاحظات لسير الدروس في عدد من المدارس ٠

ملاحظات خاصة كتلميذ درس على نفس النظام ٠

المملكة الاردنية الهاشمية، وزارة المعارف ، مناهج مدارس البنين الابتدائية والثانوية، مطبعة الاستقلال ، سنة ١٩٥٠، ١٩٥١ ٠

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