

PREFACE

Of late it has been the usual error that the  
study of nature in Ghanaian schools has been in the  
form of the modern teacher regarding the child as a  
passive recipient of imparted knowledge and therefore  
concentrating on his own acquired knowledge from books and  
which, in most cases he lacks any practical  
knowledge. This project was designed to help the  
teacher to discover and



METHOD PROJECT ON THE TEACHING OF SCIENCE

IN THE PRIMARY AND MIDDLE SCHOOLS

By

EMMANUEL OFORI MANTEAW

1961-62

## PREFACE

Of old it has been the usual order that the study of nature in Ghanaian schools has been in the form of the modern teacher regarding the child as a passive recipient of imparted knowledge and therefore dumping on him his acquired knowledge from books and of which, in most cases he the teacher lacks any practical knowledge. This promotes rote learning and apart from sealing off the child's exploratory, discovering and developing mind, it does the child the greatest harm in swallowing with pleasure and delight every written information especially in books or imparted knowledge, especially from his elders and seniors without thinking about its validity or possibility. The result is failure on the part of students to give correct answers to such simple questions as "How does the aeroplane fly?" or "How is the gramophone able to give out music?" and attributing the phenomena to magic. At times the explanations too are animistic or religious. To eradicate this is what every country should set about to do, and Ghana especially has this in view, in trying to stamp out the old approach to scientific knowledge and adopting the new. Instead of Nature Study and Hygiene, Natural Science is to be taught. This is necessary in the Middle School and my remarks on them.

because apart from giving the child more topic to be learnt, the former two subjects lack the practical work, the only process of helping a child to discover and to understand natural phenomenon. In adapting practical work in the teaching of science, the teacher does not only render the child as a passive recipient of imparted knowledge but also as one learning most readily while actively pursuing some problem or project. He not only watches the developing mind but also guides it and provides it with the right environment and the right nourishment. Much room is by this way given to the child to expand his knowledge and experience through discovery. He is then able to give logical and reasoned out answers to simple questions about what happens everyday around him.

Before this new approach to the study of Natural Science is adopted in Ghana, there is the need for experimenting how far they are feasible here. This is among the many works now being undertaken at the Institute of Education of the University of Ghana where I am now a student and one of the participants in this work. I had my project work, which is here divided into tow main sections under the headings, "The Problems"; mainly conditions I found necessary to be fulfilled to help make the teaching of science in the Primary and Middle Schools a success; and "The Project"- giving an account of some of the experiments I conducted especially In the Middle School and my remarks on them.

b) The most important aspect of the teacher's task that should not be overlooked is the necessary preparation

### THE PROBLEMS

I For the successful implementation of this new scheme - the teaching of science in the Primary and the Middle Schools in Ghana, I realised from my project work in Apenkwa Primary and Middle Schools, the following necessary conditions which must be provided or be available in the schools. The first and foremost the teacher. Furthermore the teacher is able to help the more when

a) The Teacher:- The teacher of science in the Primary and Middle Schools need not be a graduate or necessarily a school certificate holder who has learnt science to the school certificate standard. Rather he should be a person who is always ready to learn rather than impart and in doing so he must have those essential qualities of a successful teacher. These may include love for both the children and the lesson, in this case science, which he teaches. Nor should the teacher lack the quality of finding out through experiments and not only through the medium of reading from books. He should be well informed and always keep abreast with current ideas through reading. A pupil teacher who was in the school told me "After all the lessons are not as difficult as I thought" The average teacher in the Primary and Middle Schools has all the requisite qualification to teach science in the Primary and Middle Schools.

beforehand. Previous preparation helps the teacher to plan his lesson systematically well, leaving out all unnecessary

b) The most important aspect of the teacher's task that should not be overlooked is the necessary preparation before conducting any experiment at class. I found out that every apparatus constructed whether by teacher or the children needed some special adjustment on it to make it most effective. The teacher should always, in order to be sure of an impending experiment try his experiments at home successfully before he brings them to the classroom. Furthermore the teacher is able to help the more when he knows where and when in the construction of pieces of apparatus or conducting of experiments children are likely to go wrong. An example of this happened in my lesson on the "Expansion of Metals" during which an apparatus was constructed to indicate the expansion of copper wire when heated. I found that the maximum effect was obtained when the end of the broom stick was less than two inches from where the stick had been hooked or suspended. In the course of the lesson therefore I examined children's pieces of apparatus to see whether this provision had been satisfied, and most of the children were saved from an unsuccessful experiment <sup>that would have ensued. There were</sup> which I found ~~some experiments which I~~ needed planning and preparation at least a day or more before the lesson was conducted. Whatever the qualifications of a teacher might be my experience has shown me that the teacher will face a greater probability of rendering himself a failure if he fails to prepare beforehand. Previous preparation helps the teacher to plan his lesson systematically well, leaving out all unnecessary

ones and bringing in helpful steps. Another important thing about the teacher is his method of imparting knowledge to the children. A well planned lesson very rarely meets with a failure. Whenever my lesson was well and satisfactorily planned, I had a greater grasp of it and the lesson proved more lively and successful. A lot of questions were asked by teacher and they were carefully answered by the children. There was much opportunity left for children's participation and the attention of the children was successfully secured. Lack of adequate planning might have resulted in an otherwise manner. In that case the teacher would have done most of the talking while children might have sat passively swallowing the knowledge being imparted only to forget all the next day.

The teacher should not be over-ambitious in his method, and should avoid rushing children through the lessons. There must be adequate room for discussion during which children's questions are lucidly and carefully answered. In the Middle or Primary School the teacher should not lecture nor should he be incapable of maintaining discipline and interest. A lesson will be void of all these requisites if not well planned, hence the need for a carefully planned lesson.

The second problem is for the teacher to know what previous knowledge children have, and how they have been conditioned to think. The first task of the teacher is to

discourage children from giving animistic and religious answers or explanations to natural occurrences. My first question "Why do the drops of water thus formed in the sky come down to us?" in the course of a lesson on Air was answered by a girl in Primary 5 that "Because God wants us to get rain". I held a stone over her head and asked her what would happen if I let the stone free. She said it would fall on her head. I then asked whether God liked it so, and she said "No". Further discussion helped her to know that it was a natural phenomenon. On the first day of my teaching science in the Middle Form Three, a boy asked whether it was not by magic that the Europeans had been able to construct aeroplanes and wireless sets. Before I could answer him there was another hand up. Wishing to know that boy's opinion on the question I asked him to speak. He said Europeans practise witchcraft and it was by the powers of that, that they invent and construct wireless sets and new machines. I explained to them that there were many things happening around us that we failed to notice. These natural phenomena could be made use of in devising and constructing new machines and engines to serve humanity and lessen human labour. The study of the natural phenomena, finding the cause and the effect of them is what has brought about science and the new inventions, and it was exactly what I had come there to find out with them. Hallucinations are things of the expansion of metals. I also found out that the present dual desks are too heavy to be lifted when a new

the teacher of science should discourage because apart from militating against the logical reasoning of children it actively tames children to become passive recipients of knowledge, swallowing every fact without questioning. Until quite recently most of the literate folks in Ghana believed that whatever appeared in the Newspapers was right and true; and most teachers at present regard all the knowledge they get from books as being correct. The ultimate effect of this is rote learning which exist even in the higher institutions.

The third problem which is the curriculum presented no difficulty. On the time table there is in the Middle School, a double period for Nature Study followed immediately by a period for Hygiene. This continuous period of ninety minutes I think, is adequate for the teaching of science in a week. As far as the teaching of science is concerned the topics as I found them had all been carefully selected to satisfy the "Let's find out" method in which there was much room for experiment and discussion.

The fourth and last problem was apparatus and classroom equipment. I found out that most of the pieces of apparatus could be made during the "Art and Craft" period. This will afford the teacher enough time to expand his lesson and develop it further to be linked with everyday life. (Refer to my remarks on my first lesson on the expansion of metals) I also found out that the present dual desks are too heavy to be lifted when a new

arrangements of the desks is needed. The slopping tops too allow bottles to slide. I suggest flat tables shall serve the purpose better.

Glass tubes which I found to be too fragile to be handed by primary children could be replaced by transparent plastic tubes. I found it necessary for each school too to have a special cupboard in which science materials are kept. Such things as empty bottles, jam jars, cigarette tins, nails and pieces of wood can be kept in it and be made ready for use by all other teachers. Most of the things should be provided by the school and the teacher, because it is not always likely that the children shall be able to bring things like coal pots and charcoal to school. It often occurred that children failed to bring the materials I asked them to bring, and in such cases I had to use my own. I realised that most of the materials needed for experiments were things that could be laid hands on in almost every village and there will be no excuse for the lazy teacher who tries to shift the blame of lack of preparation to lack of materials.

EXPERIMENT ON THE EXPANDED CURRICULUM

First lesson on the "Expansion of Metal"

Date: 6 : 2 : 62

Class: MF 2 and MF 3

Solution: Middle Mixed

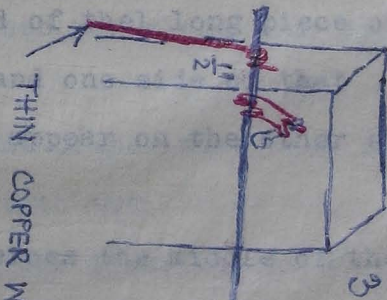
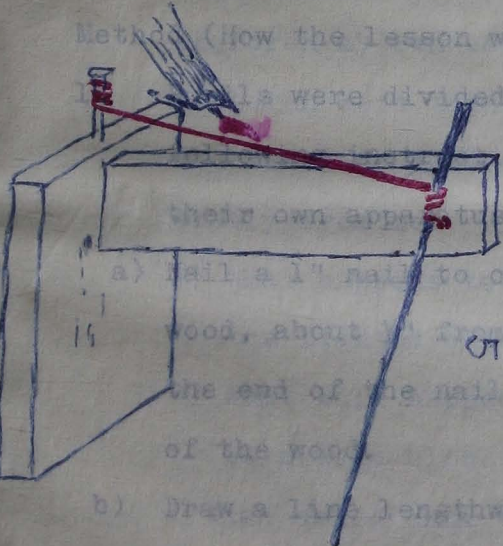
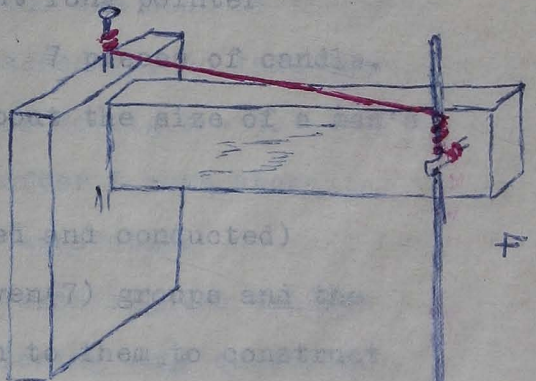
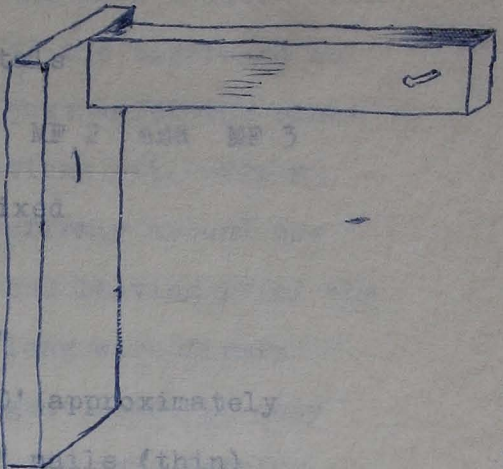
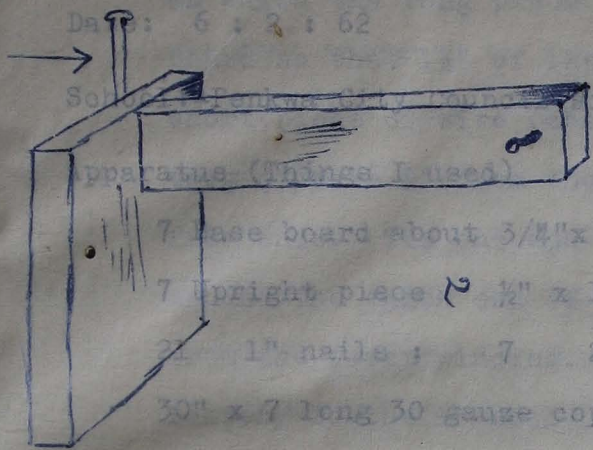
Apparatus (Things Used)

- 7 base board about 3/4"x 4" x 6"
- 7 upright piece 2 1/2" x 1 1/2" x 20" approximately
- 21 1" nails ; 7 2" x 1 1/2" nails (thin)
- 30" x 7 long 30 gauge copper wire; 21" long
- 30 gauge copper wire; A light long pointer
- 7 twigs from palmrachs)
- 3 hammers and four stones about the size of a man
- fist; A box of matches.

Method (How the lesson was planned and conducted)

The class were divided into seven (7) groups and the apparatus were given to them to construct their own apparatus.

- Nail a 1" nail to one end of the long piece of wood, about 1/2" from top and one at the bottom of the end of the nail just in and out of the wood.
- Draw a line lengthwise across the middle of the base board. Hammer a 1" nail into the wood along this line 1/2" from the edge and another 1/2" away from this one along the same line so that they come out a little on the other side. Put the base board



THIN COPPER WIRE

A LIGHT STICK (PALM RACHIS)

EXPERIMENT ON THE EXPANSION OF METAL (COPPER WIRE)

First lesson on the "Expansion of Metals"

Date: 6 : 2 : 62 Class: MF 2 and MF 3

School: Apenkwa City Council Middle Mixed

Apparatus (Things I used)

- 7 Base board about  $3/4$ " x 4" x 6"
- 7 Upright piece  $1/2$ " x  $1\frac{1}{2}$ " x 20' approximately
- 21 1" nails ; winding. 7 2" x  $1\frac{1}{2}$ " nails (thin)
- 30" x 7 long 30 gauze copper wire; 21" long
- 30 gauze copper wire; A light long pointer
- 7 twigs from palmraxis) 7 pieces of candle,
- 3 hammers and four stones about the size of a man's fist; A box of matches.

Method (How the lesson was planned and conducted)

1. Pupils were divided into seven(7) groups and the following instructions given to them to construct their own apparatuses.
  - a) Nail a 1" nail to one end of the long piece of wood, about  $1/2$ " from top and one side so that the end of the nail just appear on the other side of the wood.
  - b) Draw a line lengthwise across the middle of the base board. Hammer a 1" nail into the wood along this line  $1/2$ " from the edge and another  $1/2$ " away from this one along the same line so that they come out a little on the other side. Put the base board

over the long piece and hammer the nail to it.

c) Hammer a 2" nail into the edge of the baseboard on which the long piece stands just under the baseboard so that 1 1/2" of the nail sticks out. Tie a short piece of wire (about 2 1/2") firmly around the twig of wire 3/4" from the thick end leaving 1" of the free ends. Tie one end of the long wire firmly around the thick end of the twig at least 1/2" away

1. from the first winding. Attach the twig fairly loosely to the 1" nail on the upright wood. Stretch the long wire and wind the head of the 2" nail that sticks out the baseboard, so that the twig hangs horizontal. Refer to fig. 1-5. This construction was done after I have shown to children my own constructed apparatus.

2. Children were then supplied with lighted candles and asked to answer the following oral questions orally from me.

a) What happens to you when you place your hand over the lighted candle?

b) What will happen to the copper wire when the flame is placed close or put to it?

I then asked chn. to put the flame to the stretched copper wire, and to watch carefully the pointer.

After this had been done I asked chn. to remove the candle.

instructions, and fails to explain them with diagrams.

The following questions were then put on Bb for chn. to answer: the above apparatus even though I had

e) Feel the wire. Is it hot? What has happened to it?

d) What happened to the copper wire and the stick

3. From when the flame was put to the copper wire?

h) What do you think causes the stick to fall?

f) What then happens to a metal when it is heated?

Remarks (What I found out and my suggestions) the copper

1. I found out that whereas the construction of the apparatus occupied most of the period for the lesson, it was just a means to an end. Chn. directed their attention rather to the construction of the apparatus and the rising and falling of the broom stick rather than they did to the main lesson - which was the expansion of the copper wire. In order to save time and to render the construction of the apparatus less important, I suggest that the apparatus should be constructed during art and craft period.

If children asked why they are being asked to construct them the teacher should tell them they shall be used during their scientific experiments.

2. I realised that although in the pursuit of scientific knowledge one's main objective is to discover rather than to receive new facts about nature, the Middle or Primary School Science teacher will fail in his task to help chn. in this way if he only gives

a) instructions, and fails to explain them with diagrams. broom stick moving downwards?

My attempt to give Middle Form 3 pupils instructions to construct the above apparatus even though I had shown them one was a failure. I had to demonstrate at times to them.

3. From children's work after the lesson I found out that when the flame was put to the copper wire the wire became longer and the pointer dropped. Twenty-nine pupils wrote that when the flame was put to the copper the pointer dropped. One pupil actually wrote nothing about the copper wire and the pointer.

This shows that in a class of 37 pupils only (7) seven pupils were able to discover what I intended to help them to discover. The rest 31 failed to get this and 29 although could follow and see what happened yet they failed to get the main thing which was the expansion of metals. They could not link the dropping and rising of the stick with the expansion and contraction of the metal. This was what I found my method in MF 3 could not achieve. In Middle Form Two, therefore I varied my method and especially my questions. I asked the following questions to direct children's attention to the expansion and contraction of the copper wire, or to help them to link the dropping and rising of the one end of the broomstick with the expansion and contraction of the stretched copper wire respectively.

- a) What is happening to the copper wire when you see the broomstick moving downwards?

When children are able to answer this the next question should be "b) What causes the copper wire to get longer?"

In MF 2 my test after the lesson showed that out of a class of 39 only 2 could not link effectively the dropping and rising of the stick with the expansion and contraction of the copper wire. The lesson was therefore successful because the percentage of the pupils who were able to answer all the questions was about 94. In the teaching of science, it is not only the experiment conducted that helps to make the lesson more understandable to children, but also, the type of questions the teacher asks must be framed in such a way as to give the correct answer the teacher demands, apart from helping children to focus their attention and understanding on the more important part of the lesson. In Middle Form two, I found it necessary at times to ask the same type of question in another way, when some of the children failed to answer the questions correctly.

There was ample time left after the lesson in MF 2. This period was used in developing the lesson further to be linked with everyday experience. The need for spaces in between the rails of the railway line was discussed and the lesson was a lively one in which children found it easy in explaining the need for that. The expansion of the

telegraph wires during the day was also discussed with

children.

In Middle Form 3, where the construction of the apparatus occupied most of the time there was no time to

develop the lesson in this way and a lesson which ought

to be taught in one period was broken down into fragments,

for the second part to be continued during the following week.

I found that this lesson can well be taught in a period of 1 hour.

curve gets long if I put flame near it then it  
short if take it away.

MF2

Ayitey Odonkor

made experiment of board and copper wire.  
nail along stick on flat board. At the end  
the stick we nailed iron nail too there. We put  
stick there and tied it with copper wire. We light  
candle and put it near the copper wire. We see  
that the stick which we tied with copper wire  
started to ~~raise~~ rise up. And we take off the candle  
and it began to ~~raise~~ rise more than the  
we put flame near the copper wire.

MF2

Amarin Adom

When you put the flame besides the copper <sup>wire</sup> wayer you see that the stick is coming down but if you took the flame, the stick started to go up. And after a few minutes it came down again. And I put the flame besides the copper wire and the stick started to shake that is what I did see in this lesson.

MP3

ANTHONY LAMOTTE BARTLEY

What I did today

by what I did is that we are our teacher gives us

something made of wood and wire apply with candles

a thus stick, and the stick stick is tied to  
Copper wire and the copper wire also is tied to

metal under the wood. then he told us to light the

candles then we did so. then he told us to put the light

the wire and the we did it. But at first I saw

the thin stick is tied which is tied to the copper

is coming down, and our teacher told us to

away the light, also when we did I saw that

is going up, at first I thought it was magic

is one of my friend told me that it is a sign.

Anthony

M.F.3

Simon Kuater

What I did

What I did was when we came from  
laying a certain teacher who came onire,  
is can come today and give some - ner  
thing like magic to us, he give us ne  
wood and wand there is Flat wooddle  
der. There is nail up and down and  
it was tied with wire, The Teacher  
checked and told us light it and  
also told us to put on the wire  
we put the fire on it goes down  
if take it off them it goes up.

## WHAT I HAVE DONE

### Things that I used.

At first I used two pieces of wood, a thin copper wire, 4 nails, a stick (palmrachs) a candle, hammer and a box match. I took the two pieces of wood one long and another broad and hammer the middle of the wood with two small nails, then at the end of the long pole I put one nail there. I hammer one nail also at the bottom of the pole. Then I tight a small piece of wire to a stick.

## WHAT I HAVE FOUND OUT.

How I found that, if I placed the candle to the wire then the stick goes down and slowly when if I take light from it then the stick goes up. The wire gets long if I put flame near it then it gets short if I take it away.

Week 4

TERM 2

MF3

What I have done

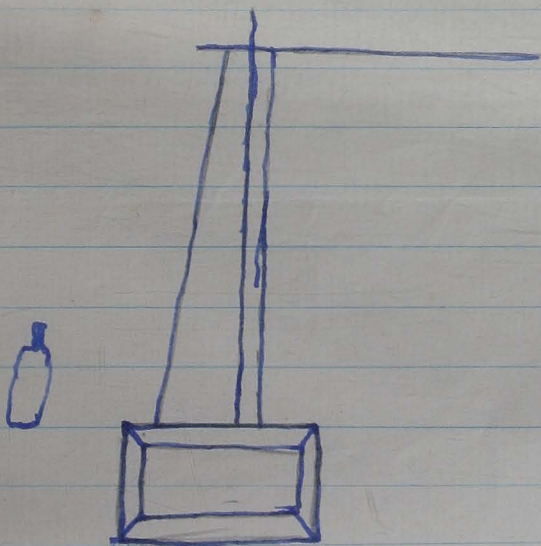
6/2/62

I have done an experiment -

At first I took two pieces of wood and nailed them by nailing the ends of the woods, (I took 1 thin copper wire and tied it) I nailed one end and another end, and I took one thin wire and tied the nail down at the southern side, to the stick at the northern side. Then I finished I took my shot copper wire to fitted the stick and a nail up, then I make a hook around the nail. And I took my candle and my match and lighted it the candle. Then I put the candle from the south to the north.

He

What I found out: I found that if the wire get becomes long on the stick gets down and if the wire becomes short on the stick gets up and the wire becomes black.

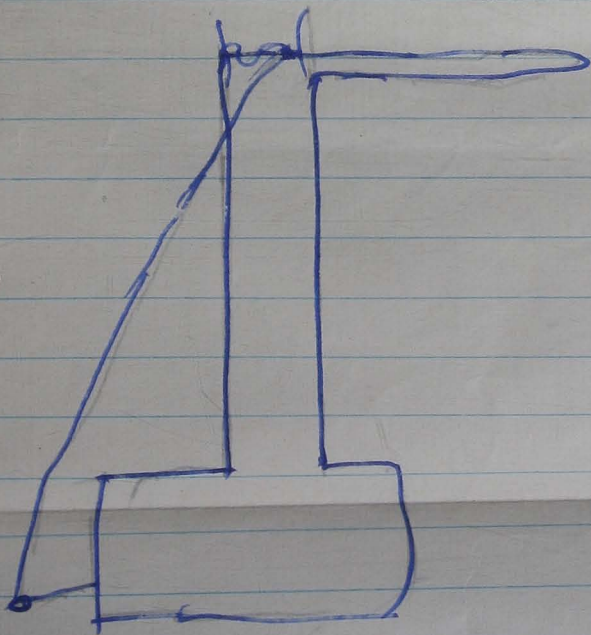


What I have done

I have done an experiment.

We used two pieces of woods, one flat and the other long. A thin copper wire, and a short one. We used four nails, ~~first~~ wire and a hammer, a candle, and p. base of matches.

At first, we hammered ~~to~~ the two wood together, made it strong enough enough. When we have finished, we tied the two wires together. And hooked it with the stick. When we have finished doing it, the candle was lit, then the candle was used to rub rub rub it, and the flame will set the stick go up whenever the wire becomes up then the <sup>stick</sup> stick will go come down. When the wire <sup>goes</sup> go up the stick will come down.



Second lesson on the "Expansion of Water".

Date: 13 : 2 : 62

Class: MF 2 & 3

School: Apenkwa City Council Middle School.

Apparatus (Things I used)

6 empty bottles of beer, 6 glass tubes with rubber corks; 6 coal pots; 6 pieces of paper, 6 empty tins; ~~some~~ drops of potassium permanganate.

Method (How the lesson was conducted)

NB Children were asked on the previous day to bring coal pots, charcoal and aluminium receptacles for boiling water. About ten minutes to the period for the lesson, children were asked to set fire and boil the water in the six aluminium receptacles. The coal pots were placed outside to receive much air and to help the water to boil quickly.

1. Children were then grouped into six, and each group received a set of 1 bottle, a glass tube with a rubber cork and a piece of paper. I also had mine and demonstrated as I gave the following instruction.

- a) "Fill the bottles to the brim with water. Add a few drops of ink to colour the water. Gently fit them with the cork carrying the glass tube. Take a piece of paper about 2" by 8" and cut a slit about  $\frac{1}{2}$ " from either side. Push the top of the tube through the slit so that the paper forms a shield

behind the tube. Make a mark on the paper to show where the water stops

b) Bring in the boiling water and place the bottles containing the coloured water in them.

Children were then asked to watch carefully the glass tube and the water in it. The following were some of the questions which were put to children to answer.

a) How does the meniscus in the long tube move?

b) Why does the meniscus in the long tube move downwards. Children failed to answer this question and therefore the following were asked.

c) What will happen to the meniscus if the bottle is squeezed or made smaller?

d) What will happen to the meniscus if the bottle is made bigger?

e) What is happening then when you see the meniscus falling?

These questions were aimed at helping the pupils to discover what happened to the bottle when it was half immersed in the hot water i.e. expansion of the bottle.

As the meniscus - the water level, in the glass-tube started taking an upward movement or ascent, the following questions were asked.

f) What is happening to the meniscus finally?

g) What has also happened to the bottle?

h) Why is the meniscus moving upwards if both the water and the bottle have expanded?

Remarks Children's failure to answer this necessitated another question from me in this form. thinking that for

- i) What happens when two lorries with different speeds move in the same direction? and intelligently
- j) What has happened then; which is expanding greater, the water or the bottle? of the hot water. This I
- k) What then do you say about the expansion of water and solid or metal". Lesson to the previous one. To my Questions, i - k, were to help children to perceive that water expands more than solid even when they are in a vessel subjected to same amount of heat. this case the bottle.

2. After the lesson had been developed and applied to everyday life, some time was carefully reserved for Bb work and exercises. The following questions were put on Bb and after children had been given sheets of paper, they were asked to do them expanded. Some time

- A1 When a bottle is heated it on... children to
- 2 The meniscus in the glass tube moved downwards when the water was heated because... reason on
- 3 The meniscus finally moved upwards because... reason on
- 4 When water and a bottle are heated the... expands more than the... expand or increase
- B 1 Why is it that when soup is being prepared the pot is not filled to the brim? accept but to enlighten
- 2 Why do women who sell palm oil always like to heat the oil before they sell? different parts of the bottle
- 3 What will happen to the loose lid of a can containing water when the can is heated?

Remarks (What I found out and my suggestions)

I found that I had been wrong in thinking that few questions about the previous lesson on expansion of metals and which were easily and intelligently answered would help chn. to perceive that the bottle got expanded by the heat of the hot water. This I thought, as another expansion of a solid would serve as a revision lesson to the previous one. To my surprise I found that although chn. believed that the movement of the meniscus downwards indicated an increase in the size of the container, in this case the bottle, they were not ready to accept that the bottle had actually increased in size. This misconception necessitated my questions c, d and e, to be asked. There were 4 boys and 1 girl who accepted the answer from a child that the bottle had expanded. Some time had therefore to be spent on getting children to perceive this, and I considered this necessary because I realised from the above that my lesson on the expansion of metals (or solids) had not well been understood and accepted. I realised that the children had a notion that a bottle cannot expand or increase in size for this will only result in a breakage of the bottle. This I had to accept but to enlighten children more on it that it is only when there was an unequal heating on different parts of the bottle

Richard Owen  
which forced some parts to expand greater than others that resulted in a breakage. Further B<sup>6</sup> work and

When  
The level of the water  
downward's when to water  
the bottle became larger  
When the water in a glass bottle is heated  
explanation and discussion helped children to understand and believe that the bottle really expanded.

Contrary to the above, so easily were the children able to understand and perceive that heating the water in the bottle caused the water to expand, that enough time was left for exercises to be done on the lesson and also for the lessons second important part - its application to everyday life, - to be discussed.

The following show the table of pupils in MF 2 and MF 3 who were able to answer the questions corretly

Question	Correct answers in MF2	Correct answers in MF3
A 1	27 / 39	25 / 43
2	37 / 39	36 / 43
3	38 / 39	40 / 42
4	36	40
B 1	30	32
2	33	29
3	35	34

The lesson was more lively in MF 2 than it was in MF 3. The pupils in MF 2 asked more questions than what the MF 3 pupils asked. The result of the exercises show that either the lesson was more understood in MF 2 than MF 3 or perhaps the children in MF 2 are more intelligent than the pupils in MF 3.

Richard Ofori

MF2

- ① When the bottle is heated it becomes larger ✓
- ② The level of the water in the glass-tube moved downwards when the water was heated because the bottle became larger ✓
- ③ The level of the water finally moved upwards because the water becomes more ✓
- ④ When water and a bottle are heated the bottle expands more than the water ✓
- ⑤ Why is it that when soup is being prepared a pot is not filled to the brim
- ⑥ Because the soup will drip into the pot ✓
- ⑦ Because they want it to become more ✓
- ⑧ When the water in a can is heated the water in it will be more ✓

6  
7

- 1 When ~~the~~ a bottle is heated it will be bigger.
- 2 The level of the water in the glass tub moved downwards when the water was heated because the bottle had ~~expanded~~ expanded.
- 3 The level of the water finally moved upward because the ~~water~~ <sup>hot</sup> water become more.
- 64 Be The ~~wome~~ like to heat it because they want it to be more.
- 5 The pot is not filled to the brim because it would poured ~~in~~ down.
- 4 When the water and a bottle are heated the water ~~would~~ will expands more the bottle.
- 7 It ~~will~~ will expands and the water will be more.

ME3

The things I used

Salamatu

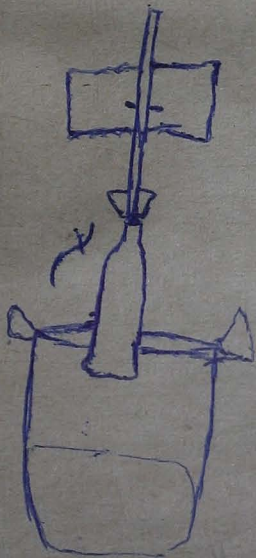
used glass-tube fitted to a cork, bottle, coloured water  
paper, hot water in a can.

What I did?

first of all fixed the glass-tube fitted to a ~~cork~~ cork  
the bottle, and the bottle ~~was~~ <sup>is</sup> full of coloured  
water, and put on a paper ~~on~~ <sup>in</sup> the middle of of  
glass-tube. After that I put the bottle filled  
in the coloured water into a hot water in the can.

3. What I found out?

found that when you put the bottle full <sup>of</sup> coloured  
water into the hot water the colour water becomes  
goes upwards because the water increases.  
if you take off the bottle the the water  
stops going <sup>up</sup> down, but coming down.



When a bottle is heated it expands.

The level of the water in the glass tube moved downwards when the water was heated because the bottle expands.

The level of the water in the glass tube finally moved upwards because the water is hot.

When water and a bottle are heated together the water expands more than the bottle.

Because the heat expands the pot.

They do that because the water it increase.

The water will produce hit and the hit will take away the lid.

Seth Lanyon

MF3

When a bottle is heated it increases in size

The level of water in the <sup>glass tube</sup> ~~in the~~ moved downwards when the water was heated because the bottle expands

The level of the water in glass tube finally moved upwards because the <sup>water</sup> bottle in bottle heated

When water and a bottle are heated together the bottle expands more than the first

and will <sup>be</sup> blown off by the heat of water

Third lesson on the Expansion of Air.

Date : 20th & 23rd February, 1962 Class MF2 & MF3.

School: Apenkwa City Council Middle Mixed School

Apparatus (Things I used)

6 empty bottles; 6 glass tubes with corks.

Method (How lesson was conducted)

1. The lesson was started by asking chn. the following questions on the expansion of solid (metal) and the expansion of water.

What happens to a metal when it is heated to become very hot? Does the size of water remain the same when it is heated? Which of the two require more heat for expansion, water and metal? Which expands more than the other when heated, water or metal?

This questions were<sup>to</sup> summons children's attention and prepare them for the new lesson apart from linking the old lesson with the new one.

2. Children were then divided into six groups and were also given the following instructions to perform.

"Colour a small amount of water with red ink: Dip the end of the tube near the cork into the coloured water and when the water has come about  $1\frac{1}{2}$ " up the tube cover the top end with the fore finger.

Keep the top covered and carefully fit the cork carrying the tube into the mouth of the beez bottle and remove your fore finger from the top of the tube.

size Leave the tube to stand and watch the position of the air in column of the coloured water in the tube. After three raised seconds one group reported of a rise of the coloured warm. water in the glass tube. The other groups were and 35 asked to warm the bottles with their hands by grasping the bottles firm.

Before children were asked to grasp the bottles firm with their hands the question "What is in the bottle that we do not see?" was asked. In Middle Form two all the class but two girls raised up their hands to answer the question. They all agreed with the boy who answered that the bottle was filled with air.

As the drop of coloured water started to rise in the tube children were asked the question "What pushes up the coloured water in the glass tube? The answer was promptly given "the air". I think the words "what pushes" in the question helped the children to get the answer so easily. For knowing that the bottle was filled with air, it could hardly be anything but air that was in the bottle that would do that. My next question was found to be a bit more difficult and it was "Why is the coloured water being pushed up?" The first answer was "The air wants to get out". I asked why the air wanted to get out and no one could answer. I then asked what was happening to the size of the air in the bottle when it tries to push the drop of water up. The answer was instantatious and given as the space was being left inside the bottle by the rising air.

size was increasing. My next question was then "Why is the air in the bottle increasing in size? A boy suddenly raised up his hand and answered that the air had become warm. "What has made the air warm? was my next question and 35 hands were up in MF 2 to agree with the boy who said heat from the palms warmed the air.

Children were then asked to remove bottles to a cool place under Mango trees standing in front of the school and where the wind was strongest. The drops of water in their glass tubes stopped rising and children were able to explain this that the air had been cooled down by the cool breeze. Children were then asked to send the bottles into the sun. The air in the bottles became once more heated and the drops of water in the various glass tubes started rising up.

Children were interested in the experiment and when the question was asked "What happens to the air when it is heated to become warm", all hands were raised up and the answer was given by a girl as "The air increases in size".

In Middle Form Three there was a boy who disagreed with the boy who gave the answer that the air in the bottle was expanding or increasing in size. He argued that the air having been heated had become lighter and was therefore rising up. To him there was nothing of expansion but rising of hot air to leave a place for a cooler air to occupy. To this boy I asked the question whether a space was being left under the bottle by the rising air.

The child fortunately enough said "No". I then asked him whether he thought cold air could pass through the bottle to fill that space. He answered "No" I then asked what type of air filled the bottle and he said, warm air.

I then asked him if the same quantity of air was trying to push up the drop of water in the glass tube then what was happening to it. The boy answered that it was becoming bigger in size and he agreed with us that the air was not rising but expanding.

The lesson took exactly one hour fifteen minutes to last. The following questions were put on blackboard for children to answer on pieces of paper distributed to them.

1. What pushes up the drop of water in the glass tube?
2. Why does the air in the bottle expand when the bottle is held with both arms?
3. What happens to the air when it is warmed?
4. What will happen to a lorry tyre with the greatest amount of air it can contain in it, when it gets very warm?



The child fortunately said "No". I then asked him whether he thought cold air could pass through the bottle to fill that space. He answered "No". I then asked what type of air filled the bottle and he said, warm air. I then asked him if the same quantity of air was trying to push up the drop of water in the glass tube then what was happening to it. The boy answered that it was becoming bigger in size and he agreed with us that the air was not rising but expanding. The lesson took exactly one hour fifteen minutes to last. The following questions were put on blackboard for children to answer on pieces of paper distributed to them.

1. What pushes up the drop of water in the glass tube?
2. Why does the air in the bottle expand when the bottle is held with both hands?

3. What happens to the air when it is warmed?
4. What will happen to a lorry tyre with the greatest amount of air it can contain in it, when it gets very warm? The air expands in size.



MF3

~~Moscow University~~

89

- 2/62
- (1) The air pushed up the drop greater in the glass tube.
  - (2) The heat of air both arms lie the air in the bottle expand.
  - (3) The air expand when it is heated
  - (4) When Corny Tyre ~~is~~<sup>is</sup> filled of greatest amount of air it will it burst.

89

mi  
le  
t  
to  
as  
to  
to  
or  
ms  
sed  
ette

MF3

## Richard Ofori

- ① The air pushes the drop of water in the glass tube
- ② The air in the bottle expand when is heated with both hands because of the heat in the both hands.
- ③ When the air is heated, the rises up
- ④ When it gets very hot will burst.