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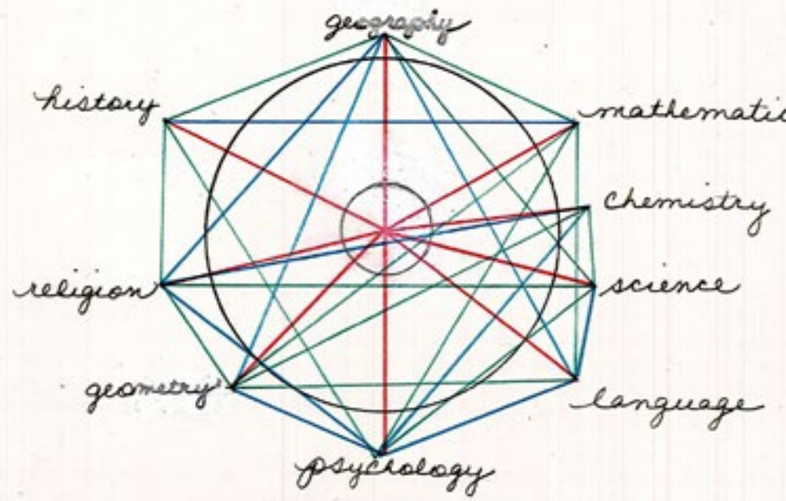
GEOGRAPHY

INTRODUCTION

Often geography is regarded as a secondary subject. But sciences do not exist in isolation; all the subjects together form part of man's life. Geography is the subject which unifies them all, which brings together man's culture.

The word geography comes from the Greek word meaning "to write about the earth." It is the science which studies the physical and biological phenomena of the earth, and the reciprocal actions between the phenomena and the earth. (reciprocal actions: phenomena totally interrelated.) On the other hand, the earth is man's house, the environment in which man grows and develops. Thus, in the study of the earth, we can research from the historical, from the biological, and from the chemical point of view.

The following figure represents the Perugia display of 1956 in which we see the interrelationship of the various disciplines. It is an impressionistic, analytical, synthetic representation of the culture of man: all subjects originate from the center of the earth. If we considered each subject as separate, we would be presenting simply an analytical vision of the world. But we don't want to present it this way, as a dead science. We do not want to offer a subject as closed, finite.



And so, with red ribbons running from the earth to the subjects, we see all united--- and with the green and blue ribbons we see the interwoven net of interrelationships. With this net of ribbons, we seem to represent the reconstruction of the earth. It is new tissue, new material.

In Dott.sa Montessori's "From Childhood to Adoslescence" she says: let's give the earth to the child. This is an idea of synthesis: not part of the world, but the whole. Montessori indicates that we must sow the seeds for all of the sciences during this sensitive period of the imagination. We give the idea of the whole, showing that from each branch a science develops. Then the study of the details will enlighten the whole. The child has the imagination to understand the whole; then the details illuminate that vision. The analytical view is used by the child to better understand the whole.

GEOGRAPHY, INTRODUCTION. . .

The child from seven on learns and assimilates the culture of his own group. It is done, not just passively, but through his emotions. Knowledge for this child must go beyond the sensorial impressions: we must make use of his imagination. And we must remember that he not only wants to know things, but he wants to know the reasons, the causes of the phenomena. He has abandoned the closed environment of the closed sensorial experience. He wants to go beyond what he can touch and see. No longer are his senses enough to guide him. Therefore, his imagination is very important; it allows the child to go beyond the concrete.

Now he works with his imagination, the most powerful force of this age. He must imagine what we cannot give him. We must take care to base this imagination in something real, or that imagination will be lost in the emptiness.

The child is ready to explore his new environment, the world. His imagination can take him into space, into matter, to the future and the past---but it must begin with something real. If the child desires to possess the world, we must find the means to strike his imagination. When we do this, we capture his interest.

The teacher must find those details which will enlighten the whole. Because he wants to know everything, the detail will whet his interest for knowing more. What must the teacher do to answer this need? Montessori says that from 6-12, it is not enough to love and understand the child; one must understand and love the universe. We must learn to understand the cosmic functions of the universe and those of the beings which inhabit the earth.

Geography is the key to open the door on this unexplored world. Knowing this encourages us to explore the discipline well. Geography, at this age, must be given with scientific exactness. . .adapted to the child's elementary age. And we must bear in mind that all subjects are related to psychology. So geography must be given according to the psychological needs of the child.

HELPS FOR THE FIRST KNOWLEDGE OF THE EARTH

For each successive plane of development, we have different materials, aids for those specific ages. The child needs to observe, to do his own experiences, and to abstract from phenomena the concepts. That is, to reconstruct those concepts through symbols. Before age 6, the child had certain aids to help him understand the whole. Montessori says that the teacher must incarnate the whole in order to convey it to the child; this whole, before his mind's eye, will be the base into which he can properly place each detail.

We say "the earth is the globe on which we live." But we also say "the earth receives the sun's rays, and the earth moves around the sun with the rest of the planets." So we do not isolate the earth from the universe. We do not talk about plants and animals without first talking about the earth. And so, the first materials for geography are four globes.

GLOBE #1 : of two surfaces, the smooth surface being water and the rough, the land. This globe is met during the sensorial education of the child. It has other sensorial characteristics: its spherical form (stereognostic sense), and two different colors (blue water and light beige land).

Presentation

1. Take the first globe, with a certain solemnity, to the child's desk.	1. This is a globe. This globe represents the earth on which we live.
2. Write on a slip: Earth. And place it below the globe.	2. Our earth, is of course, not like this representation. It is MUCH bigger.

GLOBES. . .
First Presentation. . .

3. Point out the land and water, giving the nomenclature.	3. This rough part represents land. This smooth part represents the water.
4. Second and third period lessons.	

DIRECT AIM: To give the precise concepts: the shape of the earth and the two fundamental elements which form it: land and water.

Age: casa (but a second presentation can be given in early elementary to prepare for the successive globes)

GLOBE #2: The sensorial part has disappeared; the tactile stimulus gone. There is now only the two colors: the visual impression: land is white, water blue. It is a little bigger. There are no words.

Presentation

1. Place the second globe close to the first and take them both to the child's desk.	1. See---our earth has grown. It doesn't matter if this one is bigger because both of them represent the earth which is MUCH bigger than either one.
2. Set the first globe aside. Repeat the nomenclature.	2. This is the earth. This white area is land. This blue is water.
3. Mark the child's position with a pencil dot.	3. Where do you live on this globe? Let's mark that spot with a tiny dot. The place where we live is represented by this little dot. It is big enough to hold all of us, but it is very small in comparison with the earth.

. . .and strike his imagination.

DIRECT AIM: To give the concept of water and land, using only two color distinction--- and to bring a personal dimension to the study of the whole.

Age: casa, repeated in the early elementary

GLOBES. . .

GLOBE #3: On this globe we find different colors for each continent: water is blue, Africa is brown, Europe is pink, Asia is yellow, America is orange, Australia is dark pink, Antarctica white.

Presentation

1. Put together on the desk the second and third globes.

   1. Both of these globes represent the earth. On both the water is blue. But on this globe the land is different colors---here on this globe the land is all white. But both the spaces---the colored parts on this and the first white---represent land.

2. Point our the spot where child lives. Mark with a pencil point.

   Let's find the tiny spot where we are located on this globe.

3. Beginning with child's own, give the name of the country and other familiar countries as you give the name of the CONTINENTS. Nomenclature.
   NOTE: Continent: one of the large divisions of unbroken land.

   As the continents are introduced, note the shape and position of the continent. (recognition of geometric forms in the continents is a help for general recognition of the continents)

   We live here---in Italy. And all this light pink area is called Europe. This color yellow covers a large area of land close to Europe. It is called Asia. This brown part is called Africa. It looks like a triangle on the bottom and the top part looks like a trapezoid. Each of these: Europe, Asia and Africa is a large unbroken division of land that we call a continent. Let's see if we can find three more.

4. If the child is familiar with some, give the nomenclature for all six continents.

5. Second and third period lessons.

6. Activities: Comparison of continents size?

   6. Which is the biggest continent? (Asia, America, Africa, Australia, Europe, Antartica)

   The child draws a continent with a very simple shape (Africa as the triangle and the trapezoid; South America as a triangle, North America as a trapezoid). This is not to draw a precise contour, but to help the child conceptualize the general shape.

7. Introduce the nomenclature of the water. . .using the continents as points of reference.

   7. Also the water receives different names according to its position. Usually big bodies of water are called oceans. And big enclosed bodies of water are called seas.

   Give the nomenclature of the ocenas:

   Between America and Europe there is the Atlantic Ocean. Between America, Asia and Australia there is the Pacific Ocean. Below Asia, close to India, there is the Indian Ocean. There is a small ocean at the top of the earth: the Arctic Ocean. And an ocean around the continent of Antarctica called the Antarctic Ocean.

GLOBES. . .
GLOBE #3. . .Presentation. . .

8. Second and third period lessons.

DIRECT AIM:
1) to give the names and the number of the parts of the earth.
2) to give the first intuition of the shape of the continents, the proportion of the surfaces and their positions.
3) a sensorial division of the land and the water.
4) a first definition of ocean and sea.
5) the names of the oceans and their position with respect to the land.

NOTE: See "From Childhood to Adolescence," pp. 38, 39, 40

AGE: first presentation in casa: same presentation given at the beginning of elementary.

GLOBE #4: the traditional globe (with oceans, names of places, lines, meridians, etc.)

Presentation (and use): parallel to terrestrial morphology and nomenclature; before Functional Geography; before the study of phenomena given in the impressionistic charts.

"This is the earth represented in all of its aspects."

THE GEOGRAPHY CABINET: studying the land forms

This study is undertaken before the study of real geography. The educationof the visual sense can be considered from three points of view: that of dimension (sizes,) color, and shape. In the children's house the flags were used for the sense of shape. The globes educate these senses; and so does the geography cabinet. But none of these three is truly geography. However, it is through these reading and sensorial experiences and activities that the child indirectly works in geography.

Materials (used both in the casa and the elementary)

1. The geography cabinet is formed by eight drawers, the arrangement of which depends on the country in which it is being used.
   For use in the United States:
   1) World Map
   2) North America
   3) United States
   4) South America
   5) Europe
   6) Asia
   7) Africa
   8) Australia/Central America

   NOTE: In the children's house, the first drawer starts with the country.

   Each drawer contains: maps, frames, and insets.

2. Small boxes, one for each drawer, containing the puzzle pieces for each drawer (insets) and labeled with the corresponding number.

3. Globes #2 and #3.

4. A large folder titled "Geography" which contains pieces of paper for the drawing exercises. Because each of the exercises is done with different sized maps, the paper is of a variety of sizes to fit each frame exactly and should be marked in one corner with the names of the frames for which the paper is scaled.

5. A green box labeled "Geography Cabinet Reading Labels," and containing many small envelopes, each of which contains the labels for a particular drawer or a particular group of materials within the drawer. The envelopes are labeled accordingly.

THE GEOGRAPHY CABINET. . .

DRAWER #1: Map of the World

The first drawer contains:

a) A frame of the world map obtained by dividing the globe into two hemispheres, Western and Eastern. (cut along the meridian 20° West and the antimeridian)
b) A flat map of the world which corresponds to the frame: in two circles with blue water and white land. It is the same size as the frame and used as a background for the same.
c) Two green cardboard circles as big as the hemisphere circles.

NOTE: Materials a, b, c, are used with Globe #2.

d) A second frame with the major islands shown in colors.
e) Two corresponding maps of the hemispheres, one blank and the other one with the names of the continents and the oceans. (Planishperes)

NOTE: Materials d and e are used with Globe #3.

Also used in this presentation with drawer #1 contents:

a) Small box #1 containing all the pieces of the puzzle for the two frames: the pieces for frame #1 being white and those for frame #2 being colored as they are on the second globe.
b) From the box of reading labels: 3 envelopes:
   1) Parts of the World: the labels for the continents: in a white envelope and the labels are white.
   2) Oceans: a blue envelope and blue labels.
   3) Continents and Oceans: a dark yellow envelope with white labels.
c) From the large Geography folder, corresponding paper cut the size of the frames for the drawing activities. (50.2 X 26.6)

DIRECT AIM: The point of consciousness is that the child must realize the passage from the spheric surface to the plane surface.

Presentation: Drawer #1: Part I: first frame, map, corresponding puzzle pieces and Globe #2
1. To be given immediately after the presentation of Globe #2.

1. Show first Globe #2 and then present the first world map. Be sure to give the child a clear idea of the passage from the spheric to the plane representation of the earth so that he knows both represent the earth. A rubber ball cut in half may serve.	1. Imagine if we were to cut this globe in half. We would have two equal parts. Then suppose we smash it under heavy glass. We would have a representation of the globe like this. Both the globe and the map here represent our earth.
2. Use also the green circles, pressing them around the globe and then showing that, when placed flat, the two represent the same surface of the globe as the map.	We can see that the surfaces of the two are equal with these two green circles. If we could paste the circles flat around the globe, we would cover it. When we flatten them out, we have the surface of our map.
3. Place the frame on top of the map.	
4. Show the white puzzle pieces and fit them into the frame.	
5. Repeat the nomenclature of the earth.	5. The blue represents water; the white represents the land.
6. Remove the pieces and have the child replace them: an exercise at the sensorial level: recognizing shapes.	

7. Ask the child to establish the position of the country where he lives.

8. Activity: The child takes a puzzle piece and tries to locate that piece of land on Globe #2. He is checking for the discovery of the same shape and matches it when he locates it.

9. Activity: a) The child takes from the geography envelope a paper sheet which corresponds to the first frame used here. He uses the map as a background, then places the sheet down and finally the frame.
   b) With a pencil he traces the contour of the continents.
   c) But---he has not marked the limits of the water. . .SO he puts the green circles down on his drawing when he is finished tracing. He places the green circles so that they both touch in the middle, and then uses the continents of Antactica and Australia as guides to place the periphery of the circles. He traces the circles.
   d) He colors the water blue, the frame another color, and leaves the land white.

NOTE: This is a direct preparation for writing. . .control of the hand.

AGE: work parallel to the second globe: given in the children's house and in early elementary.

Presentation: Drawer #1: Part II: second frame, two corresponding maps, corresponding puzzle pieces, globe #3
To be given immediately after the presentation of Globe #3

NOTE: In the children's house, the map with the names is not used; his work is still learning only to recognize shapes and colors.

1. Show Globe #3 and the first of the two corresponding maps---without names.	
2. Using the map as background, then superimposing the frame, the child fills in the puzzle pieces.	
3. He compares the puzzle pieces, one at a time, with those on the globe, noticing the corresponding shapes.	
4. Activity: The child takes one continent. He finds it on the globe and then he names it. If he does not remember the name, tell him.	4. Let's take this continent and look for it on the globe. Where is it? Do you remember the name of this continent? It is Asia.
When he has learned the names:	
5. Take the envelope marked "continents" containing those labels. The child matches the labels with the parts of the puzzle in the frame. Note the three Americas: introduce the new names. NOTE: There are two Antarticas, two Asias, because both are shown on both hemispheres.	5. In our labels, we find three labels for the continent America and each is different. What does each say? We have these three names because America is so large and seems naturally to be divided into these three parts. Their names show their relationship to each other: North, South and Central. Where shall we locate each? Notice, too, that we have two labels for Antarctica because part of it is shown on each of the hemispheres. And two for Asia for the same reason.

THE GEOGRAPHY CABINET. . .
Drawer #1: Presentation: Part II. . .

6. The child now works by himself with the frame, the map and the labels, using the second map as CONTROL map.

7. Introduce the envelope of ocean labels: review the names of the oceans.

7. Do you remember the name of the large body of water that lies between America and Europe?
As the Atlantic Ocean is divided here in two parts, we have two labels.
We have said that below India there is an ocean called the Indian Ocean.
Between Asia and America, there is the Pacific, here divided into two parts. . .and so again we have two labels.
For the Arctic Ocean, a glacial arctic ocean, there are two labels.
We can eliminate one of the Atlantic Ocean labels because we can put one between the two shown where they meet between the two hemispheres.

8. The child works by himself, matching these labels and controlling his work with the second map.

9. Proceed with the "Continents and Oceans" envelope of labels. The child does the matching and checks his work with the CONTROL map, second one with words.

10. Activity: drawing as in the Part I presentation---the child follows the contours, uses the circles for the hemisphere outline and colors the different parts.

#9 NOTE: He can also do this work using the blank map. . .that is, the previous #9 matching exercise. . .the frame and puzzle parts are not necessary.

AGE:
AGE: parallel to the third globe: casa and early elementary.

The Continent Where the Child Lives: Drawer #2: the pattern here is for all the drawers and is given for the continent of Europe which is Drawer #5 for the United States arrangement.

The drawer of the continent contains:
a) The frame of the map
b) 3 maps: one blank with only the division of the different countries Map #1
one with the names of the countries and the oceans. Map #2
one with the names of the capital cities of each. Map #3
country and a dot showing the location---also the oceans.
c)

Also used:
a) Two envelopes of reading labels: one marked "European countries" with those labels in white: envelope is dark yellow.
b A second envelope marked "Europe---Capital cities" with those labels---both these labels and the dark yellow envelope have special green frames around the edges for easy recognition.
b) Box with puzzle pieces for the frame, each piece a country.
c) Paper from the folder for drawings.

Presentation: As a preparation for this map which is considerably larger in scale than the Europe the child has previously seen, an exercise in scaling with graph paper may be helpful for the passage. However, the child knows from previous work that the land is much much larger and so the size of the map is not particularly important. . .the representation being the same.

THE GEOGRAPHY CABINET. . .
The Continent Presentation: Where the Child Lives. . .

1. Using the blank map #1 as a background, superimpose the frame.

2. Invite the child to put the pieces from the box in the corresponding place.
(the sensorial level: the child only recognizes the place by putting the puzzle piece into the correctly shaped space)
NOTE: the child may know the word "France" but he doesn't know where it is; so he needs this exercise to locate the countries.

3. When he can fill in all the map, give the nomenclature. He is here learning the shape and position of the country along with the name. This memorization is helped by the different colors. It should be given gradually---with a continent such as Europe, one can only introduce 5 or 6 countries at a time.

When the child knows most of the countries:

4. First Passage: Give the child the reading labels for "European Countries." He matches them with the blank land map #1. (He should be given only those labels for the countries to which he has been introduced) The child matches, checking his work with Map #2 as CONTROL.
NOTE: In addition to its use as a control, Map #2 helps the child learn new names of the countries.

5. Introduce Map #3: Capitals.

Give nomenclature.

5. You know that each country has its own capital.
Let's find the capitals of the European countries on this map.
A capital is the main city of a country.
The capital of this country is Athens.
What is this country?
The capital of Greece is Athens.

6. Second Passage: Using Map #2, with only the country's names, the child matches the capital labels to the correct countries.
Map #3 is his CONTROL.

6. Let's take one of these labels from the envelope marked "European capitals."
Athens.
Do you remember what country this city is in?
Then we'll place the label here in Greece.
And we can check to see if we have placed it correctly with Map #3.

When the child begins to know the capitals:

7. Third Passage: Using the blank Map #1, the child takes the capitals labels, locates the correct country and places the capital label on it.
His control is Map #2 for the country and Map #3 for the capitals.

This is London.
London is the capital of England.
England is here.
So---London is here.

8. Final Passage: The child uses both the labels for the countries and the labels for the capitals---there is no color difference. He matches these both, on the Map #1, using the other two maps for CONTROL of his work.

9. Activities: the same drawing activities.

THE FLAGS

INTRODUCTION

Most of the geography materials, including the flags, were born out of the children's own interests. The flags are a symbolic material. The principle of psychic economy usually preceeds the appearance of a symbol. A symbol is an expression of a concrete and immediate way of thinking. For example, it is easier to salute the flag than to understand the more complex concept of country which the flag represents. The child, like primitive man, has an early symbolic language that preceeds his understanding of concepts requiring the full development of his language. As symbols are easier to understand than the concept, many of the Montessori materials are symbolic. In mathematics, a bead represents a unit; in language the verb symbol is the sun; notes of music are symbols and the chemical elements are represented symbolically. The flags, too, are symbols that mark the beginnings of many ideas which the child will eventually conceptualize.

The materials of the flags were born in Amsterdam, the year 1937, on the occasion of the royal marriage of Queen Guiliana to Bernard. For weeks perhaps the streets of Amsterdam were full of the flags of many countries; newspapers were full of the news, the radio noted the dignitaries from various countries; the general atmosphere was one of a holiday and the children were excited. Above all, the children were impressed with all the flags in the city. They asked which countries the flags represented, and they wanted to know more flags. They were also interested in looking for those countries. Thus the geography cabinet was created. It consisted first only of the maps and frames, and later the rest of the materials were developed. The children wanted to know the names of the cities from which the important people had come for the celebration; thus we have the capital cities included.

The children asked why some countries had a kind and some a president: thus differences between a republic and a monarchy were considered and led to development of materials. They were interested, too, in the names of kings and queens and presidents. They truly wanted to know what was going on---everywhere. And so, from the limited interest in the flags came many other interests extending into history and other areas. To satisfy the growing interests of the children, the historical material "The Needs of Man" was created. "The story of the present is the study of history in the future."

And so the "Flags of Europe" gave birth to many other interests and materials. Beginning with them, a whole program was formed. There are now available, besides the European flags and related materials, the flags for the United States and Canada. In order to properly use the material, flags for all the nations of the world should be made and included in this study which embraces the whole scope of the world's peoples.

OUTLINE OF STUDY: of the European Flags

I. Nomenclature studies.
II. Flags in Relation to Geography.
III. Flags in Relation to Music Education.

I. Nomenclature of the Flags: Part A

Material

1. A series of flags for the European countries, each on a slender wooden staff.
2. Small round wooden holders, removable for the flags.
3. A wooden stand that holds eight flags in stands and holes where the staffs can be placed to display the rest of the flags. (When one of these flags is used in the presentations or work, it is removed and fitted with a wooden stand.)

THE FLAGS. . .

Presentation: Group

1. Bring the wooden stand with all the flags displayed in it to the table. Present 3 or 4 flags at a time.
   NOTE: For the sake of interest with the elementary child, choose flags which have something in common. For instance, the same group of colors or similar designs.

2. In the first presentation, include the introduction of the flag of your own country.
   An example of first grouping:
   Italy, Bulgaria, Hungary.
   Another good group: Scandinavian flags: Norway, Sweden, Iceland, Finland, Denmark (all have a variety of crosses)

   2. This is the Italian flag that we all know.
   These two flags have the same colors---green, white and red---but their stripes are horizontal.
   Our flag has vertical stripes.
   The flag with the white stripe at the top is that of Bulgaria.
   And the one with the red stripe at the top is the flag of Hungary.

3. Second and third period lessons.

NOTE: In casa, the holder is empty at first; and you add new flags as they are presented. The presentations of the flags are grouped so that they are entirely different flags in one presentation.

EXERCISES : Purpose is to relate the flag to its country.

Materials

1. A box of cards showing the flags.
2. Reading labels in the box.
3. A CONTROL chart---showing pictures of the flags and the names of the countries which they represent arranged in alphabetical order.
4. The wooden stand of flags.

A. The child lines up the flags and matches them with the picture cards. This is individual work at the sensorial level. CONTROL---visual.

B. The child takes the cards and looks for the label of the corresponding country. He matches the label to the card. Individual work. CONTROL---the chart.

I. Nomenclature: Part B: The Flag and Its Parts: parallel to Part A

Material

1. One flag.
2. A folder with picture cards and labels.
3. A booklet with picture cards and definitions.

Presentation

1. First period: declaration: giving the nomenclature.

   1. The part of the flag which supports the flag is called a flagpole; a flagstaff or a mast.
   The ball at the top is called a truck.
   The flag itself is called the field.
   The corners are called the cantons.
   A flag may have cantons of different colors or it may have stripes.
   The halyard is the cord with which it is raised.
   There are two ends of the flag: the hoist and the fly ends.

2. Second and third period lessons.
3. The corresponding exercises of a nomenclature.

II. Flags in Relation to Geography

EXERCISE #1

Material

1. A map of Europe with flags identifying the countries; no words.
2. A series of small loose cardboard flags, the same size as those shown on the map.

The child matches the loose flags to the flags on the map. A sensorial exercise which helps the child recognize the position of the countries on the map. A preparation for successive work. CONTROL: visual.

EXERCISE #2

Material

1. Map #1, as above, with flags on the countries.
2. A map of Europe, Map #2, without the flags, but with the names of the countries and red dots indicating the capitals.
3. The series of small flags.

With the help of Map #1, the child places the flags on the countries to which they correspond on Map #2. As he does so, he reads the names of the countries. He is gradually, then, associating the country with the flag.

Variation: Separate the two maps. The child takes one flag, consults the Map #1 for position and then goes to another table where he places the flag on the Map #2 country. An exercise in visual memory. CONTROL: in the material

EXERCISE #3: A Review

Material

1. Map #1 and Map #2.
2. Map #3, from the drawer of Europe, with no words.
3. The series of small flags.

Using the Map #3, the child takes the small flags; and, recognizing it as that of a certain country, locates the country and places the flag. In this case, he must remember, not only the correct flag, but the position of the country.
CONTROL: Maps #1 and #2

EXERCISE #4: Drawing the Flags

NOTE: In the casa materials are included sheets on which are drawn the contours of the flags for the children to color; and also frames with which they may trace the contours.

EXERCISE #5: Research: Collecting material on the traditions which gave birth to all the flags.
This is an interesting study because it often encompasses historical information.
A source of the origins of the flags: Bandiere di tutto il mondo, Pzeben Kannik

EXERCISE #6: Dolls of Different Countries

Materials

1. Prepare dolls with costumes of typical dress of each country, cardboard figures that will fit into cork stands, and on the back of each write the name of the corresponding country.
2. Map #2 --- with the names of the countries.
3. The series of small flags.

Presentation

1. The child places the flags on the map.
2. He then reads the country on the back of each doll and places it on the corresponding country.

CONTROL: the name on the back of each doll

THE FLAGS: In Relation to Musical Education

DIRECT AIM: To encourage musical education; to relate the country's anthem, name and flag.
INDIRECT AIM: To encourage and foster the coordination of movement.
Point of Consciousness: Just as each country has a flag, it also has an anthem.

Material

1. A collection of national anthems on record or tape. . .or the musical text and score plus a piano or guitar.
2. Flags in the wooden holder.

NOTE: It would be helpful for this presentation to learn to play the guitar first. And an introduction to the music of a country may be expanded to include the folk music and dance which increases the scope, possibilities and enjoyment of this whole series. The flags may serve as a part of this kind of activity also.

Presentation: in the music or gymnastics room, with piano or sound equipment.

1. The teacher presents a flag that the children know and plays the anthem: a listening exercise. The children stand preferably to emphasize the respectful attitude one takes when a national anthem is played.

2. Repeat with a second anthem.

EXERCISE #1: for a few children

The children walk in a line while the teacher plays an anthem. The first child to recognize the country goes to get the flag from the holder and takes it to the teacher. If the child takes the wrong flag, the teacher goes on playing the same anthem until the right flag is presented. If is is correct, the child then takes the flag back to the holder, joins the others in the line and the teacher begins another anthem.

EXERCISE #2: for many children

The children walk in a line, each with a flag in hand. The teacher plays an anthem and the child with that country's flag raises it. If the child is mistaken, the teacher continues to play the same anthem. When the correct flag is raised, she goes on to another one.

With the repetition of the anthems, we have good ear training experience.

FINAL FLAG PRESENTATION: Show the children how to salute the flag, how to fold it, and various other traditions of your country.

AGE: the activities with the flags begin in casa and continue into the elementary.

LAND FORMS: The Study of the horizontal configurations of our planet earth.

The study of land forms is an indirect preparation for real geography on the sensorial level and with the nomenclature. The work done starts in the children's house and continues through early elementary.

Material

1. A piece of plastic cloth.
2. A container of clay: that type of clay which must be worked.
3. A bucket.
4. A pitcher of water.
5. Blue ink or color powder.
6. A knife and spoon.
7. Six metal trays, approximately 40 cm. X 60 cm.
8. 3 pieces of paper---smooth surface on one side and rough on the other, each cut exactly to fit the bottom of the trays.

NOTE: This work done with the clay recalls the creation of the earth---it is important that the child work himself in order to bring order and form to the wet clay.

"And God siad, "Let the waters under the heavens be gathered together in one place, and let the dry land appear." and it was so. God called the dry land Earth, and the waters that were gathered together he called Seas. And God saw that it was good." Genesis 1: 9,10

Presentation

1. Present the clay to the children. Invite them to work it. They will get tired, they will get dirty. Sometimes there will be too much water, and sometimes it will be too dry.

   But the children work the clay until it is in order, well worked and pliable.

   The earth, at the beginning was just like this clay---barren, with no life. Clay is the substance which most clearly reminds us of earth. It is the earth.

2. Place, smooth side down, the paper in three trays and fill carefully with the clay, leveling the surface. THEN present one tray on the table and an empty tray alongside. Fill that second tray with blue water which you have prepared in the pitcher.

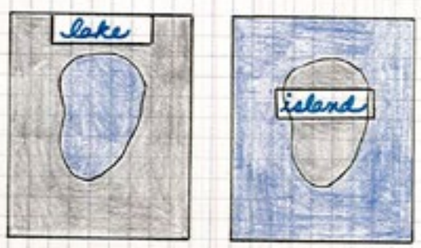
2. Now we have prepared the land. We must also prepare the water. The water of oceans and seas is not blue, but we see it blue because it reflects the sky.
   Now we have the land and the water: the dry and the wet.

3. Repeat the process three times so that three trays of each is prepared.

NOTE: In order to do this work, the child must have a certain skill: he must know how to mix the clay, how to cut the paper, how to mix the water blue and to pour it, how to fill the trays with clay. It is a good work.

LAND FORMS: The island and the lake: THE GEOGRAPHY CONTRAST

1. Take a tray of water and one of clay.
2. With a knife, draw a closed curved region, then cut through the clay and paper with a knife.
3. Take out the part you have cut and place it in the water tray.
4. Spoon water from the tray of water into the hole left in the first.
5. Note that without taking away or adding anything we have formed two things: a lake and an island.



6. Give the nomenclature: This is a lake.
   This is an island.
   Write each on a slip of paper and place it on the clay in each tray.

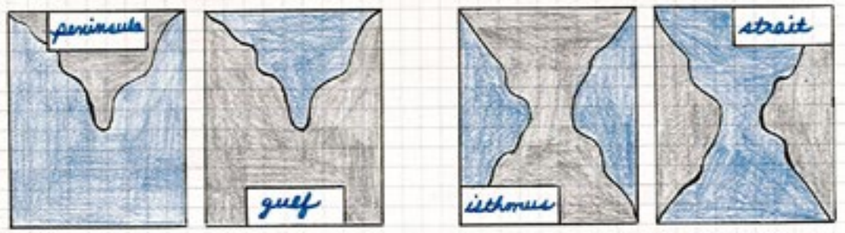
7. 3- Period Lesson.

LAND FORMS. . .

NOTE: These two are the first two land forms. The position is that of positive and negative of the same image. So we have circle and its frame twice in reversed colors. The grey color of the land and the blue of the lake are parallel to the black and white: in one relationship on the negative and the reverse of the print. In both cases---the photograph and the land forms here---we have neither added nor taken anything away. All that has changed is the position of the land in relationship to the water.

LAND FORMS: The Peninsula and the Gulf & The Isthmus and the Strait

Presentation: the same

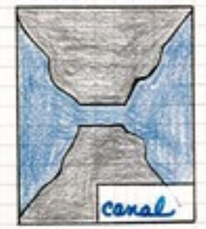


NOTE: These first three presentations are presented in the children's house.

LAND FORMS: The Canal (channel): a later presentation: the same material
This is presented when the child is working with the geography nomenclature, studying all the aspects of the earth.

1. Showing the child the isthmus land formation, note that one body of water is separated from the other. . .and we cannot cross from here to here.

2. Man, in order to save time and energy, cut a strip of this land away so that he can go from one part of the water to the other. Boats and ships can go like fish, from one body of water to the other.



3. Sail a tiny paper boat along the canal that you cut.

NOTES: It is a common mistake to confuse land forms with the plastic configurations in later studies. Here we are at the sensorial level. With the plastic reliefs we present land forms at a scientific level.
Here the land forms are presented simply, without little trees and houses. It is not a depiction of reality, but a concept of the land forms isolated.
DO NOT prepare the clay and let the children look; it is the process of preparing the clay with their own hands that provides the experience.
DO NOT use plastic clays and add water; it is the clay wherein lies the spirit of the work.
Do NOT add more land forms now. In giving many details we loose the fundamental concepts, the real aim of the work.
DO NOT represent the land forms as reality; that is, like the boot of Italy. The result is a gulf shaped like Italy which is truly terrible.
It is important to present the forms in couples; one born from the other. The form then takes a different name according to the quantity of land and water.
This is not a scientific division; neither are the definitions which evolve in the next presentation. Here we want to give only the visual definitions; now we make simple definitions which establish the reciprocal position of land and water.

Presentation: Definitions

1. Ask the child questions in order to formulate definitions.

1. Have you ever seen a lake from a boat?
   What did it look like?
   What was around the lake?
   Have you ever swum in a lake?
   Was the water salty?

LAND FORMS. . .
Presentation: The Child's Definitions. . .

1. . .formulating the definition, through a series of questions asked to the child, for a lake.

1. .Then how shall we describe a lake ? It is a fresh body of water surrounded by land.

2. Continue, formulating simple definitions for: island, isthmus, strait, gulf.

NOTE: These definitions will be a visual description of the land form in the simple words of the child's language. Scientific definitions are introduced later. But, by forming the definitions himself, the child gains an understanding of the concepts.

2. **The island is a body of land completely surrounded by water.**
The gulf is an arm of the sea extending far into the land.
The peninsula is a body of land extending far out into the water and is almost completely surrounded by water.
A strait is a narrow body of water connecting two seas. It is situated between two pieces of land.
An isthmus is a narrow portion of land connecting two bodies of land.

ACTIVITY #1: Cutting the land forms

Material
1. An envelope marked "For the Land Forms" which contains pairs of paper squares, about 10 cm.^{2} in blue and brown cardboard, or blue and brown slick paper. There should be many pairs of these squares.

Presentation

1. The teacher superimposes a blue square on a brown one and cuts a closed curved region.

2. Place the two side by side on the mat and exchange the two cut-out parts.

3. Identify the land forms created: island and lake.

4. Repeat the process for the other two pairs: peninsula and gulf, isthmus and strait.

5. The child does the activity. When he has cut and alternated the pieces, he pastes on paper the corresponding pairs and writes below on the paper the name of the land form and his definition.

ACTIVITY #2: Locating the land forms on the globe

Material
1. The six trays of the clay land forms.
2. Globe #2.

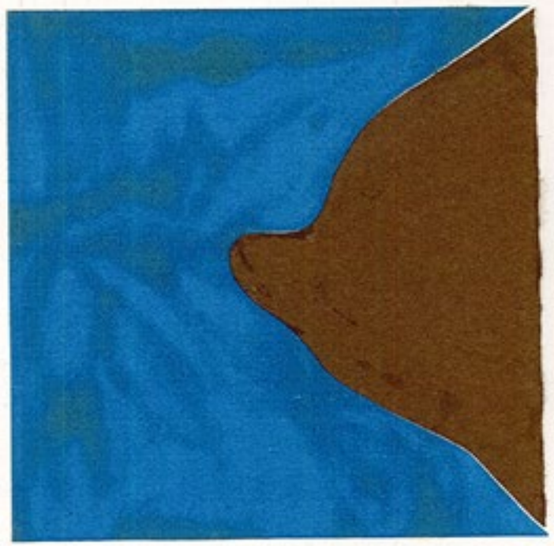
Presentation

1. The child considers one of the land forms in the trays and then looks for that land form on the globe. Es.: He looks carefully at the island which he has made, and then searches for islands on the globe. On this globe of blue and white, the land forms are particularly visible in an isolated sense.

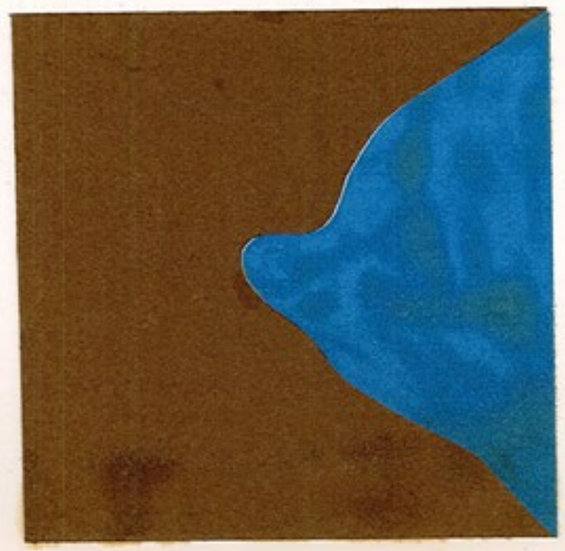
2. He repeats his investigation for each of the six forms.

NOTE: In order for the child to be able to find these land forms, he must have understood the concepts because he will not, of course, find the exact shapes that he has made. He is looking for the representation of the concept.

peninsula



gulf



LAND FORMS: Nomenclature

Materials

1. Folders with picture cards of the six land forms, shown in contrasting blue and brown as pairs of opposites.
2. Three envelopes with the definitions of the land forms:
   a) The complete definitions
   b) The same definitions, but on a card from which the subject has been cut. The subjects are grouped as a separate series of labels.
   c) The same definitions cut into parts.

NOTE: In this envelope are all the pieces cut of the six defined land forms. Each one is cut into four pieces which means 24 pieces---and that is quite a few. To facilitate the child's work, each piece is of an irregular shape. . .and all the definitions are cut in the same way. SO. . .the child can identify the first section of the definition by its shape, and the second part by the way it fits to the first.

3. A booklet with the pictures on the left side, the subject and definitions on the right.
4. The wall chart of land forms---each labeled below.

Presentation: Part A (presentation similar to that of the simple nomenclatures)

1. The teacher displays the picture cards and asks for the name of each. Restate those names which the children do not remember.

2. Then mix the cards around so that they are NO LONGER SHOWN IN PAIRS. . .and give the second and third period lessons.

2. Show me the isthmus. Which land form is this?

3. Distribute the labels and the child matches them to the cards.

4. He controls his work with the WALL CHART.

Presentation: Part B

1. The child lays the picture cards out.

2. He takes the first envelope (whole definitions). He reads the definitions and matches it with the picture cards.
   CONTROL: the booklet.

THEN

3. He takes envelope #2 (definitions without the subject). He reads the definition, then finds the subject label which it indicates, puts them together and matches the whole definition to the picture card.
   CONTROL: the booklet

FINALLY

4. He takes envelope #3. Because of the difficulty of so many pieces of these six cut-up definitions, he arranges the pieces in piles of the same shape. Thus he has the beginnings of all the definitions together, etc. He begins with the first part on which the subject is written with read and reconstructs the definition from the pieces. Finally he reads that definition "The lake is a body of fresh water completely surrounded by land," and matches it together with the picture card.
   CONTROL: the booklet

AGE: first elementary (6)

LAND FORMS: Second Level: Giving specific names to land forms of the earth

Material

1. Two series of world maps, 6 in each series. Measurements of these maps is approximately 24 cm. X 30 cm. Printed on white paper with black outline drawings of the world.
   a) First series includes a map for each of the six land forms; on each one of the land forms is shaded in red.
   b) Second series includes a paired map for one of the first six; but on these maps, besides the shading in red of one of the land forms, there is given the geographical name which corresponds for that form.
2. A series of reading labels in six envelopes, one for each land form. The labels identify those forms named on each of the six worded maps.

Presentation

1. Present one of the maps with the geographical names. The child reads the names he discovers.

1. The gulfs in the world have different names.

2. Then the child takes the blank map with only the land form shaded and he takes the corresponding series of reading labels. He matches those labels on the blank map.

3. CONTROL: the first map. Also a help as he is learning the names.

AGE: 7 - 8

CLASSIFIED NOMENCLATURE

INTRODUCTION

The main aim of the land forms work was to give a sensorial impression of the fundamental land forms. Simple forms were used to convey the concepts. But we know that the concepts are limited and innaccurate scientifically; they are organized in arbitrary pairs, and defined in very simple words.

We must now expand the knowledge of our earth. It is not enough to know the phenomena: we must know the horizontal as well as the vertical aspects of the earth's geography. So we can say that the Classified Nomenclature constitutes a third level of study of the land forms:

First Level - a sensorial experience, the land forms seen as if from an airplane
Second Level - giving the specific name to each of the forms and showing their various locations on the earth.
Third Level - all the aspects of the earth and their subdivisions. From a scientific point of view, putting each form into a corresponding chapter and giving scientific definitions.

The organization of the classified nomenclature is similar to that of geometry. We must remember that, as in geometry, this must not be an abstract experience, unrelated to reality; but must, instead, be a result of an activity: the graphic representation of practical experiences, the result of activities and explorations of the environment.

The nomenclatures are necessary for the child as a help for classifying his experiences. They provide a key so that he can classify, not in a mechanical, passive way; but in an active one.

The geography nomenclature is used by children of two different age groups: those from $3\frac{1}{2}$ to $7\frac{1}{2}$; and those from $7\frac{1}{2}$ to $9\frac{1}{2}$. There are, therefore, two different levels of presentations. Both presentations are constituted by the presentation of the concept and the definitions. But in the first group the concepts are limited in number; for the second group, besides the fundamental concepts, more difficult ones are added. The definitions for the first group are written in simple words, in familiar language, a definition that the child can use to describe what he sees. The definitions for the second group are as scientific as possible; they utilize technical language, more appropriate words. The definitions are not only descriptive, but they include the phenomena which has caused them.

Example: Group #1: Mountain range: When some mountains have the same base and form an isolated group, they form a mountain range.

CLASSIFIED NOMENCLATURE. . .
Introduction. . .

Group #2: Mountain range: The isolated group of mountains which have the same base take the name of mountain range; and are constituted by that massive group of rocks formed by the upheaval of rocks which are of a different kind than those surrounding land.

General Plan of the Nomenclature

The first division of the nomenclature is astronomic geography: a study of the earth on which we live as a planet. The other divisions of the nomenclature are aspects of the physical geogrpahy of the earth: the morphology of the earth. It studies the land and water; but it does not discuss climate nor geography in relation to biology.

It is divided into six main chapters:

I. The Earth
II. The surface of the earth.
III. Horizontal configurations.
IV. Vertical configurations.
V. The hydrosphere.
VI. Geo-dynamics.

The organization begins with the general overview and proceeds to the details. Within each chapter the same process of general to detail is then repeated internally. For instance, mountain reliefs are reviewed: then follows the different kinds of reliefs, the parts of the reliefs, the particulars of each relief.

These six chapters are organized into fifteen series, each marked with a letter of the alphabet and each of these fifteen series is composed of:

a) the folder of picture cards and labels and two series of definitions
b) the booklet (two booklets, one for each group: the simpler definitions included for the first groups work and the more detailed definitions for the second group)
c) the wall charts.

Presentation: The Pattern for the Presentation of the Geography Nomenclature
IV. Vertical configurations, F. The Parts of a Mountain

Material

1. Clay (or plasticene)
2. A plastic cloth, for covering the table.
3. Small piece of board, or heavy cardboard.
4. Tools needed to work with clay.
5. A cardboard measuring strip, marked off in centimeters, and graded from 0 --- Sea Level to 2,000 meters above sea level. Each division represents 100 meters.
6. Classified nomenclature materials belonging to this chapter.
7. Slips of paper.
8. Maps of topography: A map showing the configuration of the surface by means of contour lines drawn at regular levels of elevation. The contour line is that imaginary line connecting points on the land surface that have the same elevations.
   NOTE: Information on such maps is obtained through: Information Office
   U.S. Geological Survey
   Washington, D.C. 20242
   This office may provide some actual maps, but specifically can inform you of your local survey office where there are topographical maps available, including one such map of your own locale.
9. Newspaper, glue.

Presentation for the First Level (3½ - 7½): Group Presentation

1. With the children, construct the clay mountain, one with any shape. Mold on the piece of heavy cardboard or board so that the mountain can be moved.

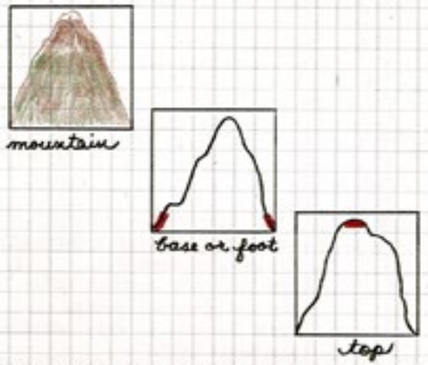
2. With the cardboard rule, measure the mountain.

2. Let's see how tall this mountain is.
   1,200 meters high----that is very high!!
   This is definitely a mountain for it is much more than 700 meters high.
   If if were less than 700 meters, we would not identify it as a mountain.

CLASSIFIED NOMENCLATURE. . .
Presentation. . .

3. Write "mountain" on a slip of paper and place it on the mountain.

4. Identify each part of the mountain in conversation with the children, and label each part named with a slip on which the name is written.



4. Let's see what the parts of the mountain are.
   This part where the land starts to rise is called the base or foot of the mountain.
   It is the foot because it is the part on which the mountain rests.
   The highest part of the mountain is called the top.
   Where are the sides of your body?
   The mountain also has sides, called slopes.
   We can place our label on any one of many sides because the mountain has many.
   When I talk about the opposite sides of a mountain, I call them the faces of the mountain. The right face and the left face.
   The "left" and "right" depends on where we are standing.

5. Remove the label slips and the child tries to match them again to the correct parts.

6. Second and third period lesson.

7. The child takes the picture cards from the folder and displays them on the mat.
   NOTE: the first card is a photograph of a mountain. The rest of the cards show only the mountain contour with the part identified in red.

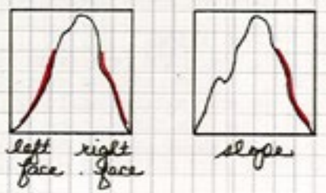
8. The child matches the reading labels to the picture cards.
   NOTE: This work is more difficult than the matching done with the three-dimensional mountain used before.

9. CONTROL: Wall Chart

ACTIVITIES: The child makes a clay mountain. Then he draws a mountain in the shape of the one he has made and marks the different parts in red.

THEN

10. Present the definitions, first organized, as with the land forms, by the children themselves with the help of the teacher's questions. Thus the definition is formed simply in their own words.



10. What do you think mountains are made of?
    Are they something flat or does a mountain rise up?
    We say that it is a relief.
    Is it small or big? How big must it be to be a mountain?
    Is it flat or tilted?
    Do you get tired when you climb a mountain?
    We can say that: A mountain is a high relief with steep sides. That the base is the part where the ground starts to rise. That the slope is the lateral surface of the mountain. That the top is the highest point. And that the faces are the opposite sides of the mountain.

11. Present the nomenclature definitions: the child matches them with the picture cards.

12. CONTROL: booklet

CLASSIFIED NOMENCLATURE. . .
Presentation: First Level

ACTIVITIES: #1: The child makes drawing of each part and then writes its definition in his own words.
#2: Field trips so that the children may explore what they have studied.
NOTE: And so he realizes that the sides of a mountain exist in reality; the exploration of the environment becomes a conscious one.

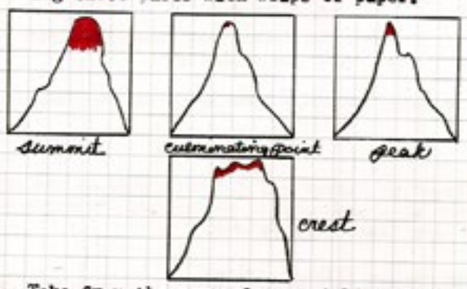
NOTE: The activities are more interesting when the child knows several land forms and the geographical terms. He is able to represent them together in clay and then he can go outdoors and discover them together.

Presentation: Second Level (7½ - 9½)

The material is the same.

1. With the constructed clay mountain, repeat the nomenclature that the child already knows and review the definitions.

2. Introduce new nomenclature---additional parts---giving the nomenclature and labeling these parts with slips of paper.



2. This part of the mountain which is often shaped like a cone at the top is called the summit.
The highest, highest point is called the culminating point.
When the top is very pointed, it gets the name peak.
When the mountain top is formed of several points, it is a crest.

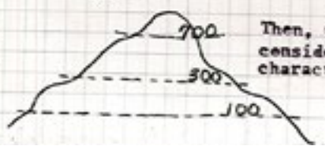
3. Take from the nomenclature folder the picture cards and display all of them, those with which the child is familiar and the new ones.
NOTE: Sometimes it is helpful to have two series if the material will be used simultaneously by both levels. Or the additional material can be added when the second level is presented.

4. The child matches the labels to the pictures. CONTROLS with the wall chart.

5. Present the definitions: review the definitions of the old parts; formulate, as before, simple definitions for the new parts.

6. Again display the picture cards, then present the nomenclature definitions.
NOTE: the child won't find the same words here as he used in his own definition. But, having made one, he will pass more easily from the simple to the scientific language.

ACTIVITIES: #1: The child makes drawings of the new parts and writes the definitions in his own words.
#2: Field trips: exploring the real thing.
#3: With the help of the teacher, the child constructs clay mountains based on the topography map. To do this, he must first isolate a section of the map and then draw a large scale map of that area, in sections if it is helpful for the large size.
NOTE: On the topography map of mountains, if the lines are widely separated, it indicates less altitude; many lines suggest a sharp incline.



Then, using his scale, the child constructs the surface in clay, considering the various heights of the mountains and the other characteristics of the surface shown.

Geography Classified Nomenclature

Chapter I. The Earth	
A.+1. The Earth on which we live	a. Earth
+2. The parts of the Earth	a. atmosphere
	b. lithospere
	c. hydrosphere
	d. barysphere
+3. The surface of the globw	a. land and water
B. 1. The strata of the atmosphere	a. troposphere
	b. stratosphere
	c. ionospere
	d. exosphere
2. Parts of the barysphere	a. mantle
	b. core
Chapter II. The surface of the Earth	
C.+1. The parts of the lithosphere	+a. continents
	b. parts of the world
	+c. island
+2. Types of islands and their groupings	a. continental island
	b. oceanis island
	+c. reef
	d. emerging bank
	e. group of islands
	+f. archipelago
Chapter III. Horizontal configuration	
D.+1. The coast and its types	a. coast-line
	b. low coast
	c. high coast
	d. irregular coast
	e. regular coast
2. Types of low coasts	a. low irregular coast-line
	b. low regular coast-line
	c. low sandy coast-line
	d. low stony coast-line
3. Types of high coasts	a. high irregular coast-line
	b. high regular coast-line
+4. Types of irreular coast-lines of emergence	+a. peninsula
	+b. promontory
	c. cape
	d. point
	e. spit
	+f. isthmus
5. Types of peninsulas	a. peninsula
	b. headland
+6. Types of irregular coast-lines of submergence	+a. gulf
	b. fjord
	c. bay
	d. cove
	e. harbor and jetty
	+f. channel
	+g. strait
	h. artificial canal
	i. lagoon
Chapter IV. Verticla configurations	
E.+1. Relief forms	+a. plain
	+b. mountain
	+c. hill
	+d. valley
	e. depression
F.+1. The parts of a mountain	+a. base (foot or stratum)
	+b. slope
	c. summit
	+d. top
	e. culminating point
	f. peak
	g. crest
	+h. face: right & left

G.+1. Groupings of mountains
- +a. mountain chain
- +b. mountain massif
- c. mountain system

+2. Parts of a chain of mountains
- a. group of mountains
- b. crest of a chain
- +c. watershed
- +d. divide
- e. orographic axis
- f. longitudinal valley
- +g. pass
- h. saddle
- i. col

3. Types of mountain chains and their parts
- a. primary chain
- b. secondary chain
- c. spur
- d. escarpment
- e. range
- f. orographic knot

H.+1. Types of plains
- +a. lowland
- +b. highland
- c. rise
- d. flatland
- e. tableland
- f. plateau

I.+1. Some types of valleys and their parts
- +a. river valley
- +b. glacial valley
- c. canyon
- d. vale
- e. valley head
- f. walls or sides
- g. floor or bottom
- h. mouth
- i. gorge
- j. precipice
- k. ravine

Chapter V. Hydrosphere

J.+1. The parts of the hydrosphere
- a. ocean
- b. sea
- c. glacier
- d. water course
- e. pooled water

2. Types of seas
- a. open sea
- b. adjacent sea
- c. inland sea
- d. interinsular sea

3. Types of glaciers
- a. alpine or valley glacier
- b. Piedmont glacier
- c. continental glacier
- d. iceberg

4. Parts of a glacier
- a. tongue of the glacier
- b. face
- c. mouth
- d. crevasse
- e. serac

K. 1. Parts of an alpine glacier
- a. collective basin
- b. ablatory basin

2. Types of crevasses
- a. marginal
- b. transversal
- c. longitudinal
- d. radial

3. Moraine and types of moraine
- a. moraine
- b. frontal moraine
- c. lateral moraine
- d. terminal moraine

L.+1. Water courses
- a. stream
- b. torrent
- c. river
- d. channel

+2. Parts of a river
- a. spring or source
- b. course
- c. bed
- d. bank: right & left
- e. mouth or outlet

M.+1. The parts of the course of a river
- a. upper
- b. lower
- c. rapids
- +d. cascade
- e. cataract
- f. meander

+2. Types of river mouth
- +a. simple
- +b. delta
- c. bird's foot delta
- +d. estuary

+3. The river basin and its parts
- a. river basin
- b. affluent
- c. subtributary
- d. tributary
- e. confluence

N. 1. Types of pooled-water
- a. lake
- b. tributaries
- c. pool or pond
- d. swamp

2. Types of lakes
- a. seepage lake
- b. crater lake
- c. ox-bow lake

Chapter VI: Geo-Dynamics

O.+1. The volcano and its parts
- +a. volcano
- +b. cone
- +c. crater
- d. conduit
- e. center

+2. Kinds of volcanoes
- +a. active
- b. dormant
- +c. extinct
- d. underwater

+3. Phases of a volcano
- +a. eruptions
- b. explosions
- c. dejections
- d. emanations
- e. extinction

+4. Volcano products
- a. magma
- +b. lava, scoria, bombs
- +c. lapilli, sand, cinders
- +d. pumice
- e. smoke, gas, vapor
- f. pine, wreath

+5. Pseudovolcanic phenomena
- a. solfatora
- b. mofette
- c. mud-pot
- d. mud-volcano
- e. fumarole
- f. boraciferous fumarole
- g. geyser
- +h. thermal spring
- i. stufa
- j. fountain

FUNCTIONAL GEOGRAPHY: Impressionistic Charts Representing the Phenomena

According to the Montesseri methedology, the land forms are first presented. The child realizes that these forms do not exist separately, nor are they still; but that they are a result of certain phenomena. Thus we must now give him the whole picture: the earth as a whole and how it functions as a whole. The child is familiar with the formation of the earth through the fable. Now we use again these charts, which were used with the tale; and we add more charts, completing the concepts and giving the details of the formation of the earth.

The charts are a key which open the door of the imaginative power of the child. They are called "impressionistic" because through them we give a specific impression to the child. We are giving the idea of the phenomena through a simple picture or symbol. By "impression" we mean "learning based on instinct rather than reasoning." Through the symbols or the colors, we strike the child's imagination. For example, in order for him to visualize the earth's coldness in the night without the sun's light, we can picture for him a poor child who is cold because there is no heat. The first is a large concept; the second a very real and close one.

The charts are organized from the general to the detail. They bear in mind the psychological needs of the child. Their point of reference is the needs of man because we are talking about the earth on which WE live. In the same way, in our histerical study of housing, we include the child's own house, which is his point of reference.

With the geography charts, we study the earth in relation to the universe and the solar system. Then the earth in relation to solar energy. Then the movements of the earth. Finally, the phenomena which modify the surface of the earth: air, water, wind, all these phenomena which have a consequence in our lives.

The organization of the charts does not follow traditional lines. There are two main differences. The difficulties are discussed one at a time. For example, we take the earth as if it were still, then we take one movement, then the second, etc. Also we have chosen only that information, those things, which the child needs.

The charts are presented to children from 8 - 11 (third - fifth grades). There are 58 charts organized in two groups:
First series: 1a - 28a: Formation of the Earth and Insolation
Second series: 1 - 30: Work of the Earth and the Water

LO STUDIO DELLA GEOGRAFIA

THE STUDY OF GEOGRAPHY

Materiale:— Serie di n. 58 carte di geografia astronomica, geologia, geografia fisica ed antropica.
Material — Le 58 carte sono organizzate in due serie:
1a serie: "Formazione della Terra ed 'insolazione'" - dal n. 1a al n. 28a;
2a serie: "Il lavoro dell'aria e dell'acqua" - dal n. 1 al n. 30.
- Set of 58 charts of astronomic geography, geology, physical and anthropic geography.
The 58 charts are organized into two series:
1st series:"Formation of the Earth and 'insolation'" - from nos. 1a to 28a;
2nd series: "The work of air and water" - from nos. 1 to 30.

— Serie di una cinquantina di esperimeni in forma di comando.
Essi sono organizzati in due gruppi:
1° gruppo: Comandi-esperimenti su "La Storia della Terra";
2° gruppo: Comandi-esperimenti di "Geografia".
- Series of about fifthy experiments in forms of commands.
They are organized in two groups:
1st group: Commands-experiments on "History of the Earth";
2nd group: Commands-experiments on "Geography".

— Materiale vario: per presentazioni ed esercizi.
- Various material: for presentations and exercises.

SCHEMA DELLA PRESENTAZIONE
(Scheme of presentations)

n° d'ordine nella presentazione del cartellone o dell'esperimento - order of presentation of the chart or experiment	Titolo del capitolo o del cartellone o soggetto dell'esperimento - Title of chapters, charts, and experiments	n° della serie del cartellone o dell'esperimento - no. of the chart or experiment
-	I. UNIVERSO-SISTEMA SOLARE-TERRA THE UNIVERSE, THE SOLAR SYSTEM, THE EARTH	-
1° esperimento	- Forza d'attarazione Force of attraction	A1
2° esp.	- Forze centrifuga e centripeta Centrifugal and Centripetal forces	A2

3° esp.	- Forza d'inerzia Force of inertia	A3a
4° esp.	- Forza d'inerzia Force of inertia	A3b
5° esp.	- Forza d'inerzia Force of inertia	A3c
6° esp.	- Forza d'inerzia Force of inertia	A3d
7° esp.	- Forza di gravità Force of gravity	A4a
8° esp.	- Forza di gravità Force of gravity	A4b
1° cartellone	- Rapporto volumetrico Sole-Terra (Quanto è piccola la Terra!) Relation between the volumes of the sun and the Earth (How small the Earth is!)	1a
2° cart.	- La Terra nel Sistema Solare The Earth in the solar system	2a
9° esp.	- L'aria calda sale Hot air rises	A5a
10° esp.	- L'aria calda sale Warm air goes up	A5b
3° cart.	- Inizio del processo di raffreddamento (La danza cosmica) The beginning of the cooling process (The cosmic dance)	3a
4° cart.	- Vulcanesimo Volcanism	4a
11° esp.	- Vulcanesimo Volcanism	A6
5° cart.	- Diluvio e raffreddamento Cooling and the filling of the oceans	5a
12° esp.	- Erosione Erosion	A7
13° esp.	- Estensione Extention	A8a
14° esp.	- L'aria occupa spazio Air occupies space	A8b
6° cart.	- Costituzione geochimica della Terra (Di che cosa è fatta la Terra) Geochimical constitution of the Earth (From what the Earth is made?)	6a
15° esp.	- Peso specifico Specific weight	A9a
16° esp.	- Peso specifico Specific weight	A9b
17° esp.	- Stratificazione delle rocce: Formazione di un bacino a sedimento Stratification of rocks: Formation of a basin by sedimentation	A10

18° esp.	- Formazione delle montagne Formation of the mountain	A11
19° esp.	- Fratture della crosta terrestre "Fracture" of the earth's crust	A12
20° esp.	- Stratificazione delle rocce: Logoramento dei sedimenti stratificati Stratification of rocks: The wearing away of stratified sediments	A13
-	II. L'ENERGIA SOLARE E LA TERRA SOLAR ENERGY AND THE EARTH	-
7° cart.	- Energia solare assorbita dalla Terra Solar energy absorbed by the Earth	7a
21° esp.	- Energia solare Solar energy	A14
8° cart.	- Se la Terra non ruotasse (Fuoco e gelo) If the Earth did not rotate (Fire and ice)	8a
22° esp.	- Illuminazione della Terra Illumination of the Earth	A15
23° esp.	- Raggi perpendicolari e obliqui The perpendicular and the oblique rays	A16
9° cart.	- Raggi perpendicolari e obliqui: medesimo numero di raggi copre aree differenti Perpendicular and oblique rays: same number of rays cover areas of different sizes	11a
10° cart.	- Raggi perpendicolari e obliqui: differente numero di raggi copre una medesima area Perpendicular and oblique rays: different numbers of rays cover the same area	12a
11° cart.	- Differenze nella distanza Sole-Terra The differences in the distance from the sun to the Earth	13a
24° esp.	- Illuminazione dell'equatore e dei poli Illumination of the equator and the poles	A17
12° cart.	- Differente dispersione di energia solare nell'attraversare l'atmosfera The different dispersion of solar energy crossing the atmosphere	14a
25° esp.	- Buoni e cattivi conduttori del calore Bad and good conductors of heat	A18a
26° esp.	- Buoni e cattivi conduttori del calore Good and bad conductors of heat	A18b
13° cart.	- Atmosfera come cattiva conduttrice del calore The atmosphere as a poor conductor of heat	19a

14° cart.	- Irradiazione (La restituzione del calore) The return of absorbed energy by the earth (The giving back of heat)	20a
15° cart.	- Calore trattenuto The retained heat	21a
16° cart.	- Calore disperso The dispersed heat	22a
-	III. MOVIMENTI DELLA TERRA E RELATIVE CONSEGUENZE THE MOVEMENTS OF THE EARTH AND THEIR CONSEQUENCES	-
17° cart.	- Rotazione e sua conseguenza (Dì e notte) The consequences of rotation (Day and night)	9a
27° esp.	- Dì e notte Night and day	A19
esercizio	- Cartelletta con disco ruotante The folder with the rotating disc	-
18° cart.	- Variazioni di temperatura in relazione alla rotazione (Qual è l'ora più calda del giorno) The variation of temperature on the Earth's surface in relation to rotation (Which hour of the day is hottest?)	10a
esercizio	- Fusi orari Time zones	-
19° cart.	- Inclinazione dell'asse terrestre The inclination of the Earth's axis	16a
28° esp.	- Obliquità dell'asse terrestre Obliquity of the polar axis	A20
20° cart.	- Rivoluzione e sua conseguenza: stagioni/globi (Le stagioni) Revolution of the Earth and the resulting seasons (with globes) (The seasons)	15a
29° esp.	- Delimitazione dei paralleli immaginari Marking off the imaginary parallels	A21
21° cart.	- Stagioni (carta) The seasons on the map	17a
30° esp.	- Le stagioni The seasons	A22
22° cart.	- Zone astronomiche Astronomic zones	18a
esercizio	- La carta-incastro delle zone terrestri per lo studio delle stagioni The chart with the inset for the seasons	-

23° cart.	- Solstizio d'estate The summer solstice	1
24° cart.	- Solstizio d'inverno The winter solstice	2
25° cart.	- Equinozi (vedi anche: "Venti e loro direzione agli equinozi") The equinoxes (see also: "Winds and their direction during the equinoxes")	3
26° cart.	- Zona torrida: ambiente Torrid zone: the environment	28
27° cart.	- Zone temperate: ambiente Temperate zones: the environment	29
28° cart.	- Zona glaciale: ambiente Frigid zone: the environment	30
-	- IV. L'ATMOSFERA E I SUOI FENOMENI THE ATMOSPHERE AND ITS PHENOMENA	-
31° esp.	- Pressione dell'aria Air-pressure	A23a
32° esp.	- Pressione dell'aria Air-pressure	A23b
33° esp.	- Pressione dell'aria Air-pressure	A23c
29° cart.	- Venti: perchè si formano Winds: why they form?	24a
30° cart.	- Venti: schema della loro formazione Winds: scheme of their formation	25a
31° cart.	- Grandi sistemi di venti regolari e zone di alta e bassa pressione Big systems of regular winds and zones of high and low pressure	26a
32° cart.	- Ventilocali: brezza di mare Local winds: the sea breeze	27a
33° cart.	- Venti locali: brezza di terra Local winds: the land breeze	28a
34° esp.	- La diversità del raffreddamento dipende dalla qualità delle sostanze The rapidity of cooling depends on the nature of the body	A24
34° cart.	- Venti e loro direzione agli equinozi(vedi anche: "Equinozi") Winds and their direction during the equinoxes (see also: "Equinoxes")	3
35° cart.	- Venti e distribuzione delle precipitazioni durante l'estate boreale Winds and the distribution of precipitations during the summer in the northern hemisphere	4
36° cart.	- Venti e distribuzione delle precipitazioni durante l'estate australe Winds and the distribution of precipitations during the summer in the southern hemisphere	5

THE IMPRESSIONISTIC CHARTS. . .

Together with the presentation of the charts, a second series of experiments is shown. The experiments for the first level, from hereforth designated as I, will be presented during the children's house work; and then repeated in the early elementary work. The second level experiments, II, are again written on cards which state Subject, Material, Command, and the question "What do you observe?" There is a second series of cards that correspond to the experiments and act as control, on which is written the statement. When the child has done his own work, he uses this card to compare his conclusions.

The teacher presents the experiments; the child then repeats the experiment later. The experiments presented for the elementary child are presented from a more scientific, technical point of view. We must point out that some substances are dangerous, that the work takes great care; and we must, as the teacher, be present at all times to control the work.

With the charts, too, we proceed to a more scientific level with the elementary child, after we note and observe with him the impression that he sees. And so our presentation of the impressionistic charts includes both the sensorial aspect and the technical.

INTRODUCTION OF THE CHARTS TO THE CHILD

Before us we have many charts. You already know some of them, but some you have never seen. You have heard the word "geography" but you may not know it means "to write about the earth." Think of all the things we can say about the earth. With these charts, we will learn more about the earth on which we live. Not just about the external part and of what it is composed, but also about the internal part. We want to know how the earth moves and what other planets are around it. We want to know all the phenomena that occur around our earth.

There was a time when the earth did not exist. Then it was formed. First it was like a baby; as it grew older, it changed. And it always changes. It will change and change, grow old and die. Fortunately, its life-span is very very long---much longer than ours. By studying it, we'll discover how closely we are united to it. We will feel proud that we are men and we will try not to ruin our earth.

THE UNIVERSE, THE SOLAR SYSTEM, THE EARTH

Remember the tale "God Without Hands?" At the beginning there was infinite darkness. And in that darkness millions of particles floated. (Experiment I: 1: cold and freezing) Many of these particles were attracted, one to the other; they formed the galaxies which seem to us like huge masses of light. Some of these particles attracted more particles. . and they get together and formed the stars. Now let's see if this piece of paper behaves as the stars did:

Experiment II: 1: The force of attraction (NOTE: don't put the pieces near the sides of the basin. Be sure to tear, not cut, the pieces. We are demonstrating cohesion.)

In this way the stars were born. Our sun is a star, and it is part of our galaxy, the Milky Way. If we see the sky on a clear night, we see a light that looks like dust, but it is, in fact, a myriad of stars.

The Milky Way has a spiral shape. In the Milky Way, like other galaxies, planets and stars float and move. (Experiment I: 2: Formation of a Star)

All the celestial bodies are suspended. They do not crash one into the other. There are two special forces which attract and repel bodies simultaneously. Thus the bodies are maintained in equillibrium. . .and they don't fall.

Experiment II: 2: Centrifugal and centripetal force. (NOTE: if we have such a body in circular motion, the hand is the centripetal force and the speed is the centrifugal force. When the hand lets go, there is no longer the centripetal force; the body does not continue in the circle, but will escape through the tangent.)

All bodies in the universe move; they are not still. The universe is dynamic, not static. The movements are controlled by certain laws. The laws maintain harmony and order in the universe. One of the physical laws is the Law of Inertia. It was discovered

by Leonardo Da Vinci five centuries ago. It explains that all bodies (matter) not under external forces tend to remain still. (Newton's First Law of Motion: A body remains at rest or, if already in motion, remains in uniform motion with constant speed in a straight line, unless it is acted on by an unbalanced external force.)

Experiment II: 3a, 3b, 3c, 3d: Force of Inertia

With the experiment of the ball drop, we demonstrated the law of inertia and we also showed the law of gravity.

Experiment II: 4a, 4b: Force of Gravity (Similar to Experiments I: 4a, 4b; don't repeat them again here)

When we rolled the ball in our experiment, it stopped because of the resistance of the air and because it was in contact with the floor. But if our floor were perfectly slick, and there were no air molecules to slow it down, it would go on indefinitely. When we dropped the ball, it fell. If we could drop the ball---or if we could threw the ball up---at the speed of 39,600 km. per hour, it would not fall: it would escape and go away from the earth. That is the speed called "escape speed." AND If I find the equillibrium between the escaping speed and the orbital speed, the ball (body) goes into orbit.

What is the universe made of? Of energy and matter. Matter is made of several substances. The number of substances which form matter is infinite. Substances can be made simple or compound; simple when they cannot be divided and compound when they can be broken apart into simple substances. Simple substances can also be called elements. The elements are made of molecules and the molecules are made of atoms.

There were, at one time, only 92 elements; now there are 103. The elements form all the compound bodies. In fact, they can be combined in infinte ways to give an infinite number of compound substances. We can compare the elements to the alphabet; with a few elements we can form many substances; with a few letters, we can form many words.

When different elements combine, they produce or absorb energy; but energy enclosed in a substance is not divisible as matter is. We can only see the effects: for energy is action. There is the same difference between matter and energy as there is between the noun (matter) and the verb (energy). Just in the same way, the verb needs the noun in order to carry out an action: and the energy needs matter to manifest itself. Then we say: movement is energy. We can only perceive energy through substances that move: the clouds, Heat is energy, but heat can only be perceived through burning substances such as carbon or wood. Matter through action is transformed into energy. For example, a burning piece of wood is transferred into heat. But energy is also transformed into matter. A burning piece of wood produces energy: through combustion of gas and other substances. We are dealing with the principle: Nothing is created; nothing destroyed.

But matter and energy are not free to combine in any way. They follow certain laws, both physical and chemical. The elements follow chemical laws when combining, and thus produce new substances. Hydrogen and oxygen combined form water (H_2O). The elements follow physical laws, too; so that some elements, when combined, do not change the substance. Water and sugar, when combined, are still water and sugar. To prove these laws, there are some experiments:

Chemical Laws

Experiment I: 9 Chemical Combination of Gas
I: 11 Chemical Reaction
I: 12 Precipitation

Physical Laws

Experiment I: 3 Solid, Liquid and Gas
I: 4 Liquid and Viscous
I: 5 Passage from Solid to Liquid to Gas
I: 6 Different States of Matter
I: 7 Particles which Love Each Other and Those that Don't
I: 8 Mixture
I: 10 Crystallization
I: 13 Properties of Liquid, Solid and Gas
I: 14 Elastic, Plastic, and Rigid
I: 15 Matter Changes State at Different Temperatures
I: 17 The Cooling of Substances Depends on the Quantity
I: 19 Matter When Heated Increases its Volume
I: 20 Quick Evaporation

THE IMPRESSIONISTIC CHARTS. . .

With these experiments, we give a first idea of the universe. Not understood as a static entity, but as a set of bodies in motion. And that motion governed by certain laws.

The Solar System---A Tiny Part of the Universe

The sun is the center of our solar system. The sun is the star which sends light and heat to the earth, making life possible. Therefore, we start analyzing the solar system from the sun.

CHART 1a: How Small Is the Planet on Which We Live!!

Senserial aspect: This is a big chart which represents a big thing! It is the sun and its crown of incandescent flames. But these flames which rise from the sun should be much longer than this because they are longer than the diameter of the sun. It would be much better to have a whole wall for the sun. Let's look at the earth---it is this tiny dot. All of us live in this dot which should really be much smaller, and not so close to the sun. The chart shows us how small earth is in proportion to the sun.

Technical aspect: The ratio of the volume of the sun and earth. The radius of earth is 6,360 km. (it is longer, of course, at the equator and shorter at the poles.) The earth is not a perfect sphere. The radius of the sun is 696,500 km. 109 times longer than that of earth. If we were to show the earth as large as a pea with an approximate diameter of ½ cm., the sun's diameter should be 54½ cm.

Let's describe our sun. It is a star. What is the difference between the sun (star) and the earth (planet). It, the sun, is a star because it sends light and heat; the planet earth doesn't---it receives the light and heat from other stars. Is our sun one of the largest stars? No. It is one of the smaller ones. But it seems large because it is so close to the earth. Other stars look like tiny shiny dots because they are very far away from the earth.

The sun's light is yellow. Other stars give different colored light: blue, white, red-orange, and deep red. The color of the light depends on the substance the star is made of; and on its age. The temperature is also different between stars. Some which are very young, are very hot: and they burn blue and white light. The old tired stars have a red-orange and deep red light. They are dying stars.

The sun's light, as everything that moves from one place to another, takes a certain amount of time to reach the earth. Even though its light is very fast, it takes that light 498 seconds to travel 149½ million kilometers. That is a speed of 300,000 km. per second or 186,000 miles per second (in a vacuum). The light of some stars takes hundreds of years to reach the earth. The closest star to the earth, after the sun, is in the constellation Centaure, called "Proxima." Its light takes more than 4 years to reach the earth. (distance, then, is four light years)

Because it would be very difficult to write these distances as kilometers or miles---these great distances between earth and a star or between stars---we have a special measure, the "light year." Then we can say it is four light years from here to the star Proxima. If you want to find out how many miles a light year is, you may make this calculation: 186,000 X 60 X 60 X 24 X 365 = And that total times four will give us the number of miles from here to Proxima. (calculated at 5,878,000,000,000) Another close star is 360 light years away from us, and there are other stars at distances of millions of light years. The light of that star may reach us after the star is dead: its light is still traveling, but it no longer exists.

The surface of the sun, seen through a telescope is not smooth. Huge flames rise from it and there are dark spots on it. The spots are due to huge holes or to tempests. They are important because they modify the energy the sun produces.

NOTE: All this information, quantities included, is given to the child to increase his curiosity; and to stimulate thought on the problems presented. We can offer him some problems, or he may write his own and solve them.

PROBLEMS: #1: Knowing that the speed of light travels at 186,000 miles per second, calculate how many miles it travels in one year.

#2: How long would it take a rocket to reach the sun if the average speed of the rocket were 1,200 km. per minute?

#3: Knowing the star Proxima is four light years away, calculate in miles, how much farther away that star is from the earth than the sun.

THE SOLAR SYSTEM. . .

RESEARCH: (Each chart may represent the starting point for researches)

A. The classification of the stars according to light and size.
B. A graph representing the distances between the earth and the main stars.
C. Information about main constellations.
D. A visit to an observatory.

CHART 2a: The Sun's Family

Senserial aspect: On this chart the earth is no longer alone; but together with other planets. With it, these planets rely on the light from the sun. This big family is called the Solar System. Each planet keeps its special distance from the sun. And each planet received a name when man discovered them. The planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto. The planets are represented in proportional size and in proportional distance to each other. The sun here is just a dot. It we represented the sun in proportion to the planets, we would need a huge chart.

Technical aspect: How was our solar system born? It is not easy to explain. We are always able only to guess, to suppose, to hypothesize. But scientists are always discovering new things that add to their knowledge, like their new and recent information about the moon.

In the last century there were several new theories. One popular theory is that the solar system was a mass of gasses, thicker internally and lighter on the outer part. The huge mass rotated on itself. This huge mass was spinning: as the speed increased, due to the centrifugal force, an external ring of it detached completely and formed a planet.

Another theory is that a star passing close to the sun, by the force of attraction, scattered parts that detached to form the different planets. We still do not know for sure. Scientists are always looking for the answers. The earth and the other planets move around the sun, following their orbits. The planets follow very precise laws which Kepler studied and formulated: called "Kepler's Laws."

We begin our analysis of the planets with MERCURY. It is the closest planet to the sun. It is very small, with a diameter of about 1/3 that of the earth's. It is very probable that there is no atmosphere on this planet. Because of its high temperatures, there is no possibility of life on it. We know very little else. It is 36,000,000 miles from the sun, (558,000,000 km.)

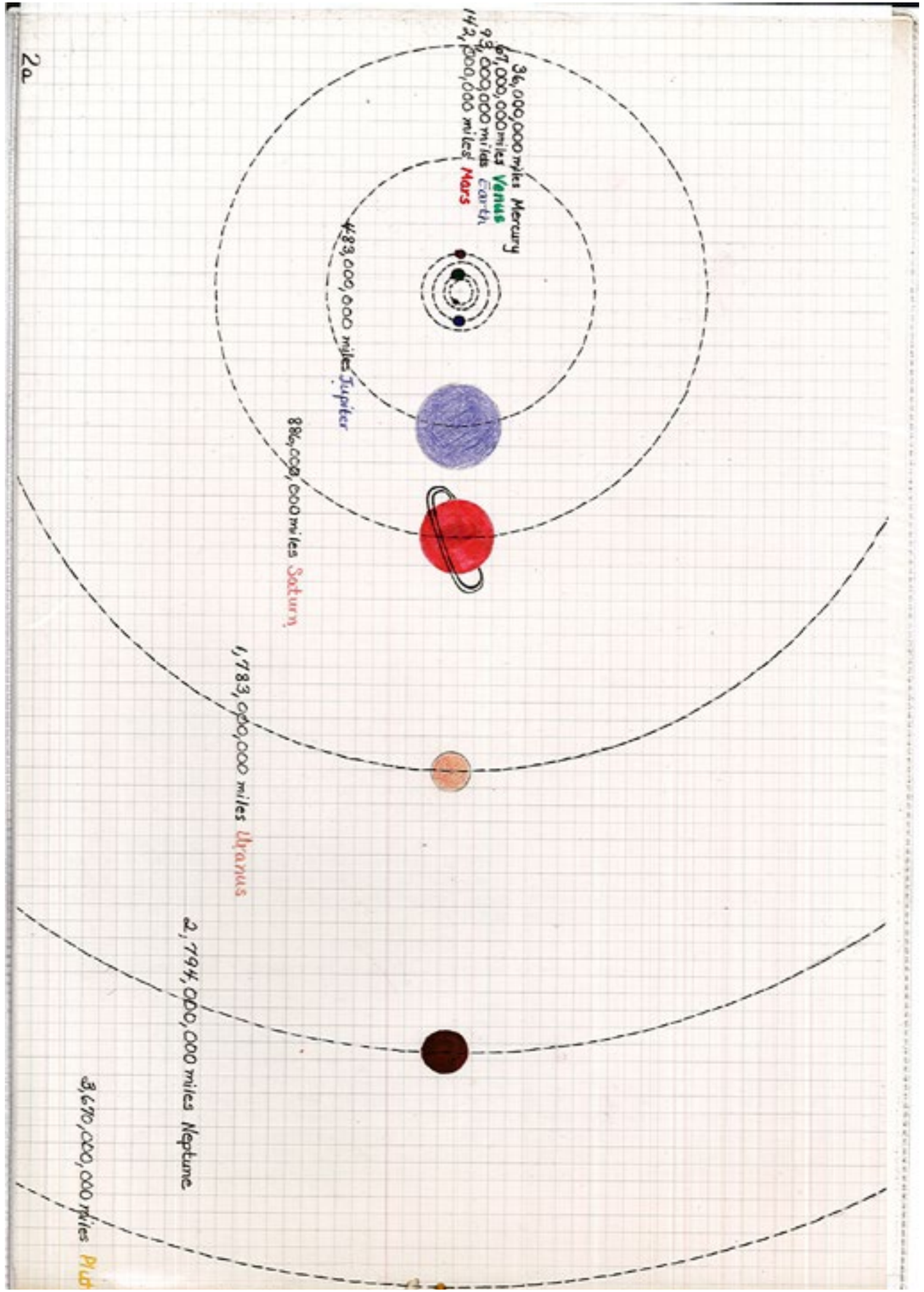
VENUS is the next planet. Sometimes we can see it before the sun rises or at sunset. It looks like a bright star. It is 67,000,000 miles from the sun, (108 million km.) It is smaller than the earth, and surrounded by a heavy atmosphere which impedes observation from the earth. Instruments tell us that the temperature is very high.

The EARTH is 93,000,000 miles from the sun, (149,500,000)

MARS is about six times smaller than the earth; and it looks the most like our earth. It is 142,000,000 miles from the sun, but the closest planet to us. Scientists believe that life could be possible on Mars. They try to discover the reason for the dark spots on the planet; and think perhaps these dark spots might indicate vegetation or even water.

"The planet Mars can be recognized from its strikingly red colour. Its brightness varies greatly; every two years its journey round the Sun brings it unusually close to the Earth, and in those years (1971, 1973) it is particularly noticeable. Viewed through a telescope, Mars is a disappointing sight. This is because it is small, hardly more than half the size of the Earth. Its orange-red color is due to the sandy deserts which cover most of its surface. White caps can be seen near the poles of the axis round which Mars rotates, which remind us of the snowy regions on Earth. On Mars, however, it is only hoar-grost, and this melts quickly during the summer. Like Earth, Mars has its four seasons; when it is winter on one hemisphere, it is summer on the other just as on our own planet. Water is scarce on Mars: so is oxygen, the part of the air which we need for life. There may well be living things on Mars, but they can be only simple plants like mosses, which do not need much water or oxygen to keep them alive." (The Night Sky, LADYBIRD BOOKS)"

NOTE: There is considerable dispute about the size of Mars. Asimov states that the mass of Mars is 1/10 that of Earth. We note that the diameter is approximately 1/2 that of earth. Santina notes from her research that the size is 1/6 that of Earth. Apparently the work is not done.



THE SOLAR SYSTEM. . .

JUPITER is the biggest of the planets in our solar system. Its diameter is 11 times that of the earth. Jupiter has twelve satellites or moons, which revolve around it. This planet is 483,000,000 miles from the sun. (778 million km.)

SATURN is surrounded by three bright rings. Its diameter is 10 times that of the earth. Its poles are flat, and it has very low temperatures.

URANUS was discovered at the end of the 18th century. Its diameter is four times that of the earth. It is 1,783,000,000 miles from the sun.

NEPTUNE was discovered at the end of the 19th century, first through mathematical calculation and then with a telescope. It is almost as big as Uranus, and 2,794,000,000 miles from the sun.

PLUTO is the nineth and last planet. It was discovered in 1930. We know very little about it. It is believed to be about as big as the earth with no atmosphere and very cold. It is 3,670,000,000 miles fromthe sun.

Some planets, such as Jupiter and our Earth, are followed by satellites which move around the planets, and are very close to them. There are also very many small planets (sometimes called planetoids or asteroids) within the solar system. Between the orbits of Mars and Jupiter are thousands of these asteroids. It is estimated that there are about 44,000 such bodies within our system. 1,600 of those planetoids are large enough to have been observed and their orbits calculated. The four largest ones were named when they were discovered between 1806 and 1845. They are: Ceres, Pallas, Juno and Vesta. (SEE Asimov: THE SOLAR SYSTEM AND BACK) All these planets and satellites move around the sun, similar to a great machine. And each part moves without damaging the other parts. The sun and the solar system move in a straight line towards the constellation of Hercules. Our entire solar system is heading in the general direction of the star Vega at a speed of about 400,000,000 miles per year. This movement is called "the movement of translation." (it translates the axis of all the orbits.)

PROBLEMS: #1: The diameter of the earth is 7,900 miles (12,700 km.) How long will the sun's diameter be if it is 109 times that of the earth?
#2: On the chart you can find the distances of all the planets from the sun. Calculate the distance between each planet and the earth.
#3: How long will it take a special car traveling at 100 km. per hour (100 miles per hour) to reach Mars?

RESEARCH: A. The teacher shows pictures or slides of the planets' orbits with proportional size. Then he invites the child to look for other pictures, slides, etc.
B. To look for news or pictures of each planet.
C. To make a graph showing the distances between the planets.
D. To write about particular space flights.

CHARTS 3a, 4a, 5a (presented together---these charts should be first displayed all together for the visual impression and then discussed in sequence)

Now we are going to talk about our earth. It has not always been like it is today. These three charts show the three phases through which the earth has gone. They show the earth before like was possible on it.

Chart 3a: The Cosmic Dance

Sensorial Aspect: When a gas is heated it tends to go upwards. But once up, it cools and falls down again.

Experiment II: 5a Hot Air Rises
II: 5b Warm Air Goes Up

The same thing happened on the earth: the hot air rose and that hot air is represented here by the angels. (We show angels because they have wings; and they are good beings who make life possible.) Their unconscious work in rising was that of carrying up some of the hot air; and they came down bringing ice. The angels are in blue and yellow representing the cold and the hot air. The angels and what they carry form a whole process and help to cool the earth in two complimentary ways: by taking the hot air away and by bringing the cold air back to it. This was a long work that went on for thousands of years----and that meant millions of angels.

THE SOLAR SYSTEM. . .
Chart 3a. . .

Technical aspect: The Beginning of the Cooling Process. The earth, as well as the other planets, detached from the sun as an incandescent mass of gasses. This mass which later became our earth moved in the infinite coldness. And, little by little, the external part began to cool and harden. In fact, the tiny particles of hot gas that rose got colder and heavier; and came back to the earth. In this way, they started the cooling process on the earth.

Chart 4a: The Time of the Volcanoes

Sensorial aspect: The surface of the earth got so cold that it formed a thin crust. But from within, the hot gasses kept breaking this crust, forming in this way a myriad of small volcanoes. And those volcanoes let out great quantities of smoke. At a certain point this smoke surrounded the earth as if it were a cloud. The thick cloud of smoke shielded the earth from the sun's rays. In this way the cooling process, called volcanism, accelerated the cooling process. (The term, known also as vulcanism, refers to the movement of molten rock materials within the earth or upon the surface of the earth.)

Technical aspect: Matter has three states: gas, liquid, solid. When it goes from gas to liquid to solid, the matter decreases in temperature. And that is what happened on the earth. Around 2 billion years ago, the surface of the earth became hard, solid. At this time the second period of the earth's life started: the period known as the Geological period.(from Geology, the science of the formation and structure of the earth's crust. It also studies the organic remains in the rocks in order to establish the cause and succession of the phenomena which occurred on the earth.) But even though the surface of the earth was solid, the internal part was very hot---and the incandescent gas constantly broke this crust forming volcanoes.

Experiment I: 17 Volcano
Experiment II: Volcanism (Here we are giving the exact process of the functioning of a volcano. We want to know why and how all the matter comes out.)

We don't know how it happened, but at a certain point, from that dense cloud, it began to rain. The surface of the earth was very hot so that when the rain hit it, it immediately evaporated.

Chart 5a: The Beautiful Daughter of the Sun

Sensorial aspect: The earth's surface finally got cooler with all this water falling. Not only did it cool the surface, but it stayed on the surface eventually, filling up all the cavities. In this way the oceans, seas, rivers were formed. The earth is still hot inside. And this fire---the hot masses---sometimes rise to the earth's surface and erupt through it. The earth's crust has become harder and more solid. The cloud which surrounded the earth has disappeared. The long night has ended and finally the sun can smile at his daughter.

Technical aspect: Rain and Cooling. Let's explain better the process of cooling. After about 2 million years the earth's crust finally got cooler. The water on the surface kept evaporating, but less quickly. The atmosphere got cooler, clearer. And the rain, besides filling the holes, got through the crust. In this way, the character of the earth completely changed. Then the earth was naked and the erosion was enormous.

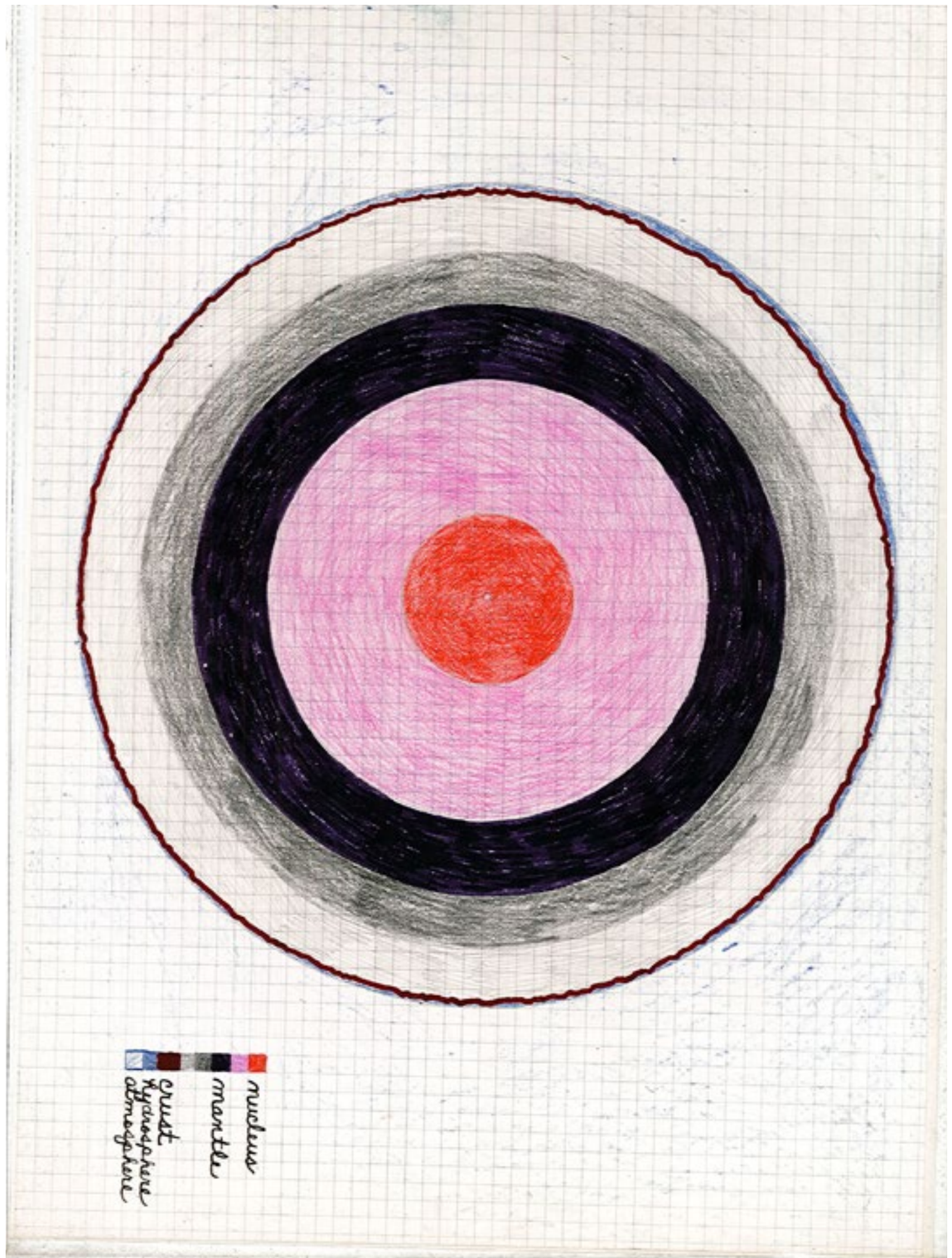
Experiment II: 7 Erosion

RESEARCH: A. Design maps of the arrangement of the continents in past ages and how these continental masses have moved and rearranged in different ways.
B. Look for pictures of volcanoes. Differentiate between those dormant and those active.
C. Look for practical examples of hot air rising.

CHART 6a: What is the Earth Made Of?

Sensorial aspect: When the substances of the earth were cooling, each arranged according to its weight without leaving any spaces.

Experiment I: 16a, 16b Gravity
II: 8a Extension
II: 8b Air Occupies Space (Each substance occupies its own space. In this way, different stratas formed. On our chart the different strata are colored in different shades.



Technical aspect: The Chemical Constitution of the Earth. We know that the radius of the earth is 3,944 miles (6,360 km.); but man has never been able to reach the center of the earth. He has been able to go about 4½ miles (6-7 kilometers) deep. So. . .how can man know of what substances the earth is made? He has discovered this by studying the cracks produced in the earth's surface by earthquakes. The movements of the earth are measured by a seismograph. When there is a quake, the waves disperse outward through the earth, not just on the surface but through the internal part. The waves propagate in different ways, according to the substance through which they have to travel. We know that the center of the earth is NOT, as was once believed, composed of boiling molten lava. The earth is not a hard crust with incandescent gasses within. The internal part is essentially solid no matter how high the temperatures. Why is it a solid state when we know that solids at high temperatures transform to liquid? Because the earth's surface exerts such heavy pressure on layers that it prevents the solid from melting to liquid. Scientists cannot reproduce the internal situation of the earth's center in laboratories; but, by studying volcanoes or the earth's cracks, they can identify incandescent gas. (lava--melted substances). Because, once the pressure is gone, the matter melts and comes out melted.

How are the different layers arranged? The core of the earth (the nucleus) has a radius of 2,113 miles (3,400 km.) On the chart it is pink and red, reflecting the scientific division of the outer and inner core. (Some scientific information indicates that the outer core, which begins at the base of the mantle, and about 1800 miles down; may be fluid.) The specific gravities of the materials composing this zone are 12.0 or more. The inner core, diameter of approximately 1700 miles, is believed to be solid. This inner core is mainly composed of iron and nickel. (NiFe: Nickel-Ferrous) The inner core, the red, is the hottest part. As we know matter arranges itself according to its weight, those substances which are the heaviest because of the force of attraction (gravity) being found at the deepest or lowest levels. The core is the densest zone; the heaviest part of the earth.

The core is surrounded by other layers, each having its own characteristics. The mantle is shown in three shades of grey. It is formed mainly of silica and magnesium, (SiMa) We hit the mantle at a depth of about 25 miles. And it is approximately 1,800 miles thick. In the first layer, the outer layer of the mantle, there is a small portion of iron which increases toward the center. The different shades of grey show the increasing content of iron. Above the mantle, there is the crust, which has a depth of about 25 miles. It is formed of silicon and aluminum. (specific gravity of the crust ranges from 2.5 to 3.4) The thickness of the crust varies greatly between the ocean basins (as little as 4 miles in places) and the continents (20 - 30 miles thick under some mountains.) The deepest part of the mantle, about ten to fifteen miles thick, is composed of simatic rocks similar to those underlying the ocean basins. The upper part of the crust is essentially granitic in nature. The base of the crust is marked by a rather clearly defined break called the Mohorovicic discontinuity or the moho. This sharp boundary, first noted in 1909 by Andrija Mohorovicic, a Yugoslav seismologist, lies twenty to thirty miles beneath the surface. On the chart, the crust is colored brown.

The nucleus and the deepest part of the mantle is called the BARISPHERE. The upper part of the mantle and the crust form the LITHOSPHERE. The earth is covered in large percentage by water (including the ground water which is part of the lithosphere) called the HYDROSPHERE. And the earth is surrounded by air which falls the earth and all its movements: this is called the ATMOSPHERE. The atmosphere is about 6½ miles high (10-11 km.) There is less atmosphere at the poles and more around the equator. The atmosphere on the chart is colored in light blue.

As we have said, matter arranged in different levels according to its weight. But we have not identified what weight is. It is the FORCE BY WHICH MATTER IS ATTRACTED TO THE CENTER OF THE EARTH. (Mass = gXa, that is, the gravitational force times the acceleration; this is not the weight, but the weight, then, is a part of the calculation for mass). This ~~weight~~ is not constant; it changes according to place. The same body changes weights, weighing ~~more~~ less at the equator than at the poles, simply because that body is farther from the center of the earth at the equator. This force that attracts bodies is the FORCE OF GRAVITY.

Note: Specific weight differs from specific gravity, which is the relative specific weight (absolute specific weight) of a mineral compared with the weight of an equal volume of water. Thus it is a ratio. A table is helpful.

Now we want to understand better how each substance has its corresponding weight. Imagine that we have boxes of the same size: we fill one with straw and one with iron. Let's place them on the scales. There won't be equillibrium even though the bodies have the same size, the same volume. This means that each substances has its own weight, which is called the ABSOLUTE SPECIFIC WEIGHT. (The absolute specific weight is the weight of a body in relation to its volume: the weight per unit volume.

$$\frac{P}{V} = \frac{45}{1} = 45$$

Because all substances here are 1 cm.^{3} cylinders, the volume is the same for each.

Experiment II: 9a, 9b Specific Weight (Density is mass per unit volume.)

Of all the parts of the earth, we are most interested in the lithosphere, that part which has greatly changed through time. During the cooling process, due to the erosive force of water, the earth's crust corregated. Reliefs were formed, reliefs disappeared, the earth was covered by water, oceans and lakes were formed. But the earth is still changing. This changing process is not as quick as before, because the earth is not bare as it once was. We are not aware of these transformations because man's span of life is so short in comparison with earth's. For us the mountain seem eternal.

But in terms of the earth's age, those mountains are like fog that comes and disappears. Mountains which were before no longer are; and those that are not will exist in time. The mountain range dividing China from India; and that one between south Yugoslavia and Greece are slowly moving. The earth's surface is not still; but always moving. As it rises and depresses the continental masses move. If the surface rises, it forms the mountains which suffer the work of erosion. If the surface depresses, a sediment basin is formed. Then the depressions are filled in by erosive work of the water and wind; and all those substances which fill the depressed part accumulate, and, in time, form the hills and the mountains.

Experiment II: 10 Stratification of Rocks (only part a presented here)
Experiment II: 11 Formation of the Mountain

In both experiments the strips of color represent the stratas of the earth. In the formation of the mountain, when the ends come closer together, the stratas wrinkle and fold in an irregular way. (We show this moving both hands together with the materials and moving only one hand.) Now in this demonstration we can no longer say that the older stratas are at the bottom, as in the sedimentary basin; because the oldest layers may have moved to the upper levels of the formation. So the mountains are formed by the pressures; by the sliding of the continental masses. Sometimes the layers of earth rise and break as a result of the great pressure.

Experiment II: 12 Fracture of the Earth's Crust

In this demonstration we discover how the different strips of color representing the different stratas have changed position. Many mountains are formed by this pressure which causes the land to rise. Once the mountain is formed, the work of the earth does not stop; the work of destruction starts.

Experiment II: 13 Stratification of Rocks, a. the wearing away of stratified sediments.

When we take off the top of the mountain, we see the layers of which the mountain is formed. We note the different position here of the grey and the brown. In the sedimentary basin the grey, the oldest strata, is the deepest layer, that which formed the external area; the brown was the internal portion. In the mountain, the grey, the oldest, is found within the internal region; the brown is the outermost layer. Thus, the age of the two is the same, but the arrangement of the strata is different.

Experiment II: 10 Stratification of Rocks, part b

THE SOLAR SYSTEM. . .
What is the Earth Made Of?. . .

The structures of the earth are made of rocks, though we have made them with materials and clay. The strata in each of the formations we described with out experiments are formed of rocks. Those rocks are an accumulation of dust which kept accumulating, becoming heavier and heavier until it formed the rocks. But not all rocks are formed in the same way. According to formation, there are three groups of rocks: IGNEOUS ROCKS (macma), SEDIMENTARY ROCKS, and METAMORPHIC ROCKS.

The youngest earth was composed mainly of the igneous rocks. These rocks are made of "macma," boiling lava which came out of the mountains, cooled and solidified. The greater part of the macma solidified beneath the surface before coming out, thus creating the granite rocks. Igneous rocks which solidified on the surface (the lava which made it all the way to the surface), formed basalt, pumice, lava, and other volcanic rocks. The rocks of macma origin do not contain fossils nor are they in layers like the sedimentary rocks. (NOTE: We must have examples of many rocks for our discussion of the rocks)

The sedimentary rocks are the most interesting ones. Formed at different periods, they are made in different layers. Often they contain fossils, useful for studying primitive ways of life on earth.

There are different ways in which the stratas are formed. Sometimes the different stratas are formed from material deposits formed by the wind, water, or ice. Sometimes they are a result of salt deposits left after salt water has evaporated, or other matter dissolved in water and left after the evaporation. Sometimes material from chemical reactions helps to form the rock stratas; or remains of organic matter such as the crustacean shells or tiny calcium skeletons. Here we may try another simple experiment, filling a pan with water that contains much salt; then boiling the water away and observing the white layer that remains. The rocks of the sedimentary origin are many: marble, chalk, clay, limestone.

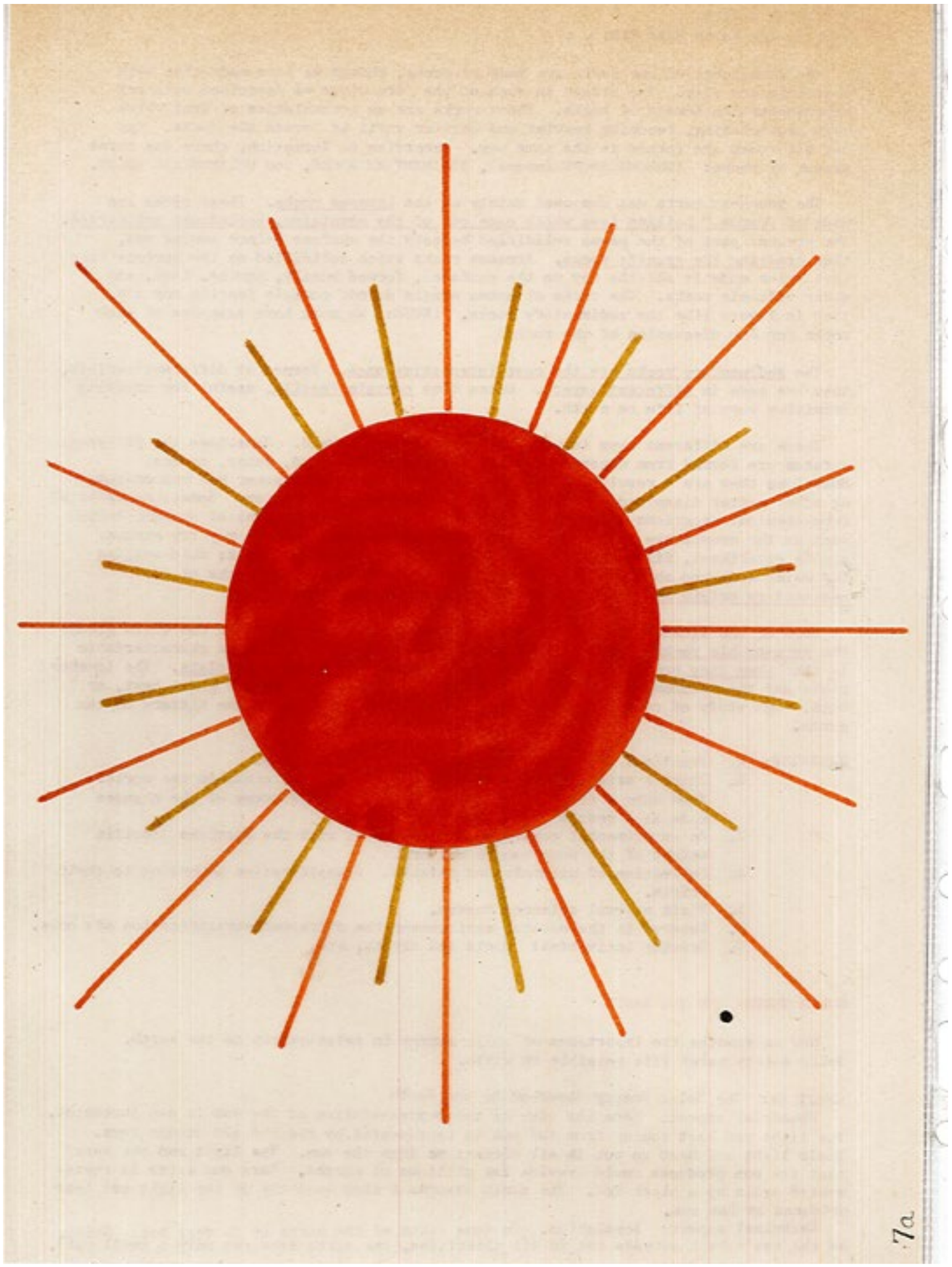
Some of the igneous rocks and the sedimentary rocks form those of the third group: the metamorphic rocks. (metamorphic means "to change.") Their main characteristic is that when they break, they break in flat pieces. An example is slate. The igneous rocks and the sedimentary rocks are transformed by high pressure or great heat, or both. Our study of rocks is important because it tells us about the history of the earth.

RESEARCH:
A. Practical demonstrations of the force of gravity.
B. Visit a seismograph center; locate the seismic areas in the world. Then make a graph of earthquakes. Collect pictures of the changes made as a result of an earthquake.
C. An experimental construction of a chart with the absolute specific weight of the most common matters.
D. Collection of minerals and fossils. Classification according to their origin.
E. Visit natural sciences museum.
F. Observe in the natural environment the different stratification of r ocks.
G. Drawing activities: rocks and strata, etc.

SOLAR ENERGY AND THE EARTH

Now we examine the importance of solar energy in relationship to the earth. Solar energy makes life possible on earth.

CHART 7a: The Solar Energy Absorbed by the Earth
Sensorial aspect. Here the size of the representation of the sun is not important. The light and heat coming from the sun is represented.by the red and orange rays. Their light and heat go out in all directions from the sun. The light and the heat that the sun produces could provide for millions of earths. Here out earth is represented again by a black dot. The earth absorbs a tiny quantity of the light and heat produced by the sun.
Technical aspect: Insolation. In some parts of the earth it is very hot. Still, as the sun's heat spreads out in all directions, the earth receives only a small part.



7a

Experiment II: 14 Solar Energy

How is solar energy produced? It is the result of chain reactions. This constant changing of the substances on the sun produces a great quantity of heat which disperses in all directions.

CHART 8a: Fire and Ice

Sensorial aspect: The earth receives a very small part of the sun's heat; but if the earth didn't rotate, this small quantity would be enough to make it very very hot on one side. On this chart, that side which is directed towards the sun is shown as fire; the other side is frozen.

Technical aspect: If the Earth Did Not Rotate. The earth has two movements. One around itself and the other one around the sun. If the earth didn't rotate around itself---if it always had the same side towards the sun, it would be very hot on one side and very cold on the other.

Experiment II: 15 Illumination of the Earth.

CHART 11a, 12a (shown together)

11a: How the Sun's Rays are When They Reach the Earth.

Sensorial aspect: These two circles represent the earth. The poles are at the top and bottom; the middle line is the equator. The yellow and red stripes represent the sun's rays. But those rays do not all hit the earth in the same way. Some rays hit the earth horizontally, some perpendicularly, some obliquely. This is one of the reasons for the unequal distribution of the heat on earth.

Technical aspect: The Perpendicular and Oblique Rays. The same number of perpendicular and oblique rays shown on the chart cover areas of different sizes. If we could take a certain number of the sun's rays, such as the six on the chart, the size of the area illuminated by those rays differ depending on whether the rays hit the earth perpendicularly or obliquely. We see the six rays on the left side coming perpendicular to the earth in the area of the equator; and the space they light is an area of about 3 centimeters. (measure to show this) Then we look at the six rays from travel obliquely toward the north. They hit the earth at this oblique angle BECAUSE THE EARTH IS A SPHERE, and we see that they illuminate a much larger area, on the chart measuring about 8 centimeters. (NOTE: the colors on this chart show the different seasons in the different hemispheres concurrently. This is another lesson)

Experiment II: 16 The Perpendicular and Oblique Rays (The illuminated area is much greater when the light is oblique.)

The perpendicular rays light a smaller area, but give a greater amount of heat to that area because the light is concentrated in that small area. When the sun's rays hit the earth obliquely, they light a larger area, but the heat is dispersed and thus less.

Chart 12a: The Sun's Rays

Sensorial aspect: Here we see the same phenomena pictured in 11a, but now we see represented only a very small area of the whole earth. The yellow and red stripes still represent the sun's rays. The sun's rays are not yellow and red, in fact; but have all the colors in them. Here those colors only indicate the heat.

Technical aspect: The Perpendicular and Oblique Rays. A different number of rays cover the same area. Here we show the same area of earth, and the rays are of the same width; but the top rays are perpendicular, the bottom ones oblique. It is necessary to have 14 perpendicular lines to illuminate an area that requires only 7 oblique rays to heat. In the first chart (11a) the same number of rays light different areas; in this chart the same sized area is illuminated by a different number of rays.

CHART 13a: The Earth Is Like a Mountain

Sensorial aspect: The earth is like a mountain. It's top is the equator here and its base the poles. The sun's rays heat the top of the mountain much more than they heat the base because the top of the mountain is closer to the sun. (Show the Globe #2 positioned horizontally with the chart to indicate the visual position here.)

Technical aspect: The Difference in the Distance from the Sun to the Earth. The chart has been divided into two hemispheres cut along a meridian. . .and we see only one-half the earth lighted by the sun. The bottom line is the axis; the arrows indicate the equatorial rays. The center point at the top indicates the equator. One of the reasons the equator is hotter is that it is close to the sun. (NOTE: the mathematical calculation is, in fact, that there is one-millionth less sun's light reaching the poles because of this distance. We might liken it to a long heater coil about two inches high and stretched out one mile. There is a fly sitting on the heater. We turn on the heat until we reach the level of heat at the poles. The fly flies off. And how we have the extra heat at the equator.)

Experiment II: 17 Illumination of the Equator and the Poles

CHART 14a: The Work of the Solar Rays in Crossing the Atmosphere

Sensorial aspect: The yellow curve represents the earth; the blue dots represent the atmosphere, the air which surrounds and protects the earth. The red lines indicate a group of rays, those coming at a 90° angle being the perpendicular rays and those at the 12° angle the oblique rays.

Technical aspect: The Different Dispersion of Solar Energy Crossing the Atmosphere. The rays which heat the earth perpendicularly have to cross an atmosphere of a particular thickness. The thickness of the atmosphere that the perpendicular rays cross is less than that part of the atmosphere which the oblique rays must cross. The more oblique the rays, the longer the strata of atmosphere they must cross. As the atmosphere takes a certain amount of heat, the oblique rays lose more heat than the perpendicular rays. We can conclude that the atmosphere protects the earth because it retains a certain quantity of heat which could be harmful to the earth. Also, this is another reason why the areas where the rays hit perpendicularly are hotter---the atmosphere is retaining, or stopping, less heat.

Experiment II: 18a, 18b Good and Bad Conductors
(Conclusion of 18b is that copper is, among those metals tested, the best conductor; then aluminum, then brass, then lead---ebony and glass being poor conductors.)

The atmosphere surrounding the earth is composed of different gasses such as nitrogen, carbon dioxide, oxygen, etc., as well as dust. Its characteristics change according to the altitude. Scientists divided the atmosphere into three layers: the TROPOSPHERE (tropo from Greek meaning "a turn), the STRATOSPHERE, and the IONOSPHERE. The higher we go, the less dense the atmosphere. (becomes rarified)

CHART 19a: The Earth Stores Heat (display now also 20a)

Sensorial aspect: The brown form represents a mountain. The red lines on the left side, becoming gradually closer and closer, as they approach the base of the mountain, represent the atmosphere that gets denser as we approach sea level. The circles represent the gasses of the atmosphere. The arrows represent the rays of the sun.

Technical aspect: the atmosphere is a poor conductor of heat. We have seen that the rays of the sun, in order to heat the earth, must cross the atmosphere. But these rays find much resistance where the atmosphere is denser. Therefore, the sun burns more on the mountain top than at sea level. Also we have the opposite phenomenon: the night on the mountain is much colder than at sea level. (20a)

CHART 20a: The Giving Back (Restoration) Of Heat: Radiation

Sensorial aspect: We still have the mountain, the atmosphere, its density and the circles representing the gasses. The arrows now have a direction toward the sun.

Technical aspect: The Radiation of the Sun: The Return of Absorbed Energy. The earth does not absorb all the heat received from the sun. It radiates some of it, dispersing it into the air. At sea level, the atmosphere is denser. The

dispersion of the heat is retarded by the strata of the atmosphere. The land and sea become warm, retaining the heat. In the mountains the atmosphere is less dense: and so the heat is dispersed by the land easily. The environmental temperature is due more to the heat absorbed by the land than by that received directly from the sun.

CHART 21a: The Retained Heat (show now also 22a)

Sensorial aspect: If a child is sleeping with a lot of blankets and there is a stove under his bed, he will be very hot. He will receive all the heat from the stove and it will be retained by all the blankets covering him. Thus the cold will not reach him.

Technical aspect: Radiation. The same thing happens with earth. Our earth at sea level is represented by the child and the stove. The land has absorbed the sun's heat, so it is like a burning stove. The blankets represent the strata of the atmosphere. The atmosphere at sea level is very dense: the heat cannot escape.

CHART 22a: Dispersed Heat

Sensorial aspect: The child is still in bed, but there is no longer a stove under his bed. His blankets are few, and the coldness reaches the child. He is very cold.

Technical aspect: Radiation. The same thing happens in the mountains where the atmosphere is not dense. The strata are few, and so the land, like the child, loses the absorbed heat and disperses it. And after the sun sets, it gets very cold in the mountains.

The earth retains the heat because the atmosphere is a bad conductor of heat, and doesn't disperse it well. Wool clothing does not let heat escape---so we wear wool clothing in the winter. People in the desert wear wool, too, as insulation against the heat. Wool, then, is a poor conductor of heat: It retains the heat within or keeps it without. In the same way, the atmosphere is like the earth's overcoat, protecting it from too much heat or too much cold.

RESEARCHES: A. Distribution of heat in different parts of the world.
B. A Graph representing the different temperatures at different altitudes.
C. Graph representing different temperatures at a place near sea level and one in the mountains.

CHAPTER III:
THE MOVEMENTS OF THE EARTH

When we are riding the train, it seems that we are still and that everything else is moving. The same thing happens when we view the stars from the earth. We see the sun rise at a certain point on the horizon. This point is called the East or the Orient (from Latin meaning to rise). Then we see the sun rise and move to the highest point and we call this point "noon" or "mid-day." We call the direction towards which the sun moves the "south." (At noon the sun is slightly south.) Then we see the sun set at a point opposite the east---called the West or the Occident. (from Latin occidere meaning to kill. The Greeks believed the sun died every day and was born again every morning.) NOTE: In another lecture, we examine more precisely these cardinal points.

In ancient times, men thought the earth was still and the planets moved around it. This was the Ptolemy theory of the Alexandrians in Egypt. In the second century after Christ, about 1500, an astronomer named Copernicus explained that the earth moves around the sun. (Kepler confirms his theory shortly after this and popularizes it). Copernicus declared that the earth was not the center of the universe, but the sun was the center. His theory was proved by Galileo who lived from 1500 to 1600. These theories were forgotten for awhile, the works of these men burned because they were heretical and contrary to the beliefs in the Holy Bible, said the high men of the church. But many years later Galileo's theory was experimentally proved. The sun rises in the morning and sets in the afternoon BECAUSE the earth rotates around itself. The earth also revolves around the sun. These are its two main movements. The first consequence of the movement of rotation is day and night.

CHART 9: Day and Night

Sensorial aspect: On this chart the earth is cut with an imaginary line going through the equator. (Show the top half of the Globe #2) The poles are not shown here. The earth's rotation movement is indicated by the arrows. Because it is round, the earth is only lighted one half at a time by the sun. If only half is lighted, that half (the top half here) is day; the bottom half, that part not lighted, is night. That part is colored blue because the night is colder than the day. As the temperature changes according to the hour, we have the top half colored in different shades of yellow.

Technical aspect: Rotation and Its Consequences. When the earth moves around itself, we say that it rotates. But as this movement is constant (the earth never stops), there is always one point on the earth where it is dawn and there is always a sunset.

Dawn is the time when the sun starts to rise. It is represented on the chart by two different strips: orange and dark yellow. Before dawn there is morning twilight, the moment preceeding dawn, a phenomenon of light reflection. The air, together with the light, produces beautiful colors. At the opposite point of dawn is sunset: at that moment daytime passes to nighttime, and the sun seems to disappear behind the horizon. This moment is the sunset. When the sun disappears from the horizon there is still light: evening twilight, due to the reflection of the light and the air. The sun at its highest point in the sky---in this apparent movement---marks a time which we call noon. Those noon hours are the hottest part of the day. At the opposite point it is midnight.

CHART **Experiment** II: 19 Day and Night
An additional exercise is noted on the experiment pages to be presented in conjunction with this experiment.

CHART 10a: Which is the Hottest Hour of the Day?

Sensorial aspect (recalls charts 8a and 13a): On another chart (8a) we saw a representation of the earth as if it were still. One half was very hot and the other was very cold. Another chart (13a) showed the earth as though it were a mountain. If we look closely at this chart, it recalls both of those drawings and it also looks like a clock. But a very strange clock!! The numbers here are still and the circle moves. The circle, then, is the earth. By means of different colors, we show the approximate temperatures of the different hours of the day.

Technical aspect: The Variation on the Earth's Surface in Relation to Rotation. It takes 24 hours for the earth to make a complete circle around itself. When the length of the day is equal to the length of the night, the day and the night will be respectively 12 hours. Noon will be 12 o'clock, 6 will be dawn, 6 sunset, and 24 (12) midnight. When the length of the day and night are thus equal, the night starts at 6 o'clock in the evening and lasts until 6 o'clock in the morning. On the chart it is colored blue because it is colder in the night. In the entire day, dawn is the coldest time for when we come to dawn, that part of the earth has been without sun for 12 hours. The sun starts to heat the air, the warm air rises and the cold air quickly takes the place left by the warm air.

The more the sun moves towards the highest point, the higher the temperature. At the highest point, the sun's rays heat the earth perpendicularly. But noon is not the hottest point. It is hottest between 1 and 2 in the afternoon. By then the earth has accumulated the heat received during these hours and the rays are still almost perpendicular. Towards sunset, the sun's rays are more oblique and the earth receives less heat. The heat diminishes till we come to sunset which is cold---but not so cold as dawn. We also notice here that the day has different hours to mark the different times of the sun. Each part has a different position in regard to the sun and therefore a different clock-time.

EXERCISE: The Time Solace

The material for this exercise is an outlined world map showing the 24 time zones; that is, it is divided by 23 meridians between each of which is shown a zone of 15°. . .
and 12 black strips, the width and length of a time zone.

This is a map that shows the world divided by imaginary lines. These lines were invented by man. He divided the earth into strips; and measured the distance between one line and the next in degrees. Each strip is called a TIME ZONE. Each time zone is limited by 2 lines called MERIDIANS.

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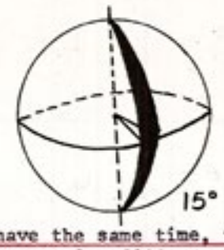
The Time Solace. . .

How many degrees are there in the center angle
of the earth? 360°
How many hours in the day? 24
So each time zone has 15°.



On the map there are really 360 imaginary meridians, but here we see only 23 of them, one every 15°.

Man has agreed that all those points within that zone will have the same time, the time at the center of the zone. Therefore we have a maximum sun-time difference of ½ hour. What do we mean then by the real hour? the apparent hour? sun-time? We should remember that these lines arenot really straight. They only serve for man's convenience.

What happens on the earth? Suppose the sun sets in Italy. Let's place this first black strip on Italy and show that it is 6 p.m. here---sunset. (Place the black strip and the hour label on this point. Then, place subsequent strips continuing to the right until all 12 strips have been placed on a time zone and each labeled according to the hour.) If it is 6 o'clock in the evening in Italy, then it will be earlier towards the west (to the left) and later towards the East (to the right.) Let's show what time it is to the east of Italy. We place another night strip on the next time zone--- it's 7 o'clock. And another east---it's 8 o'clock. When we have placed all the 12 night hours down with our black strips, we know that all that part covered in black is night.

Now, if we move all the strips over one time zone---and then another---we see that the sun is beginning to rise in the east. (Show this movement with the strips. The, having passed all the strips across to the left one hour at a time, we reach the point where we must move some from the far left position to the east again. HERE SHOW THE MAP AS A CYLINDER, giving the continuous concept of the progression of hours.)

THEN---the child works with the strips and the map, learning how to find the time in any part of the earth.

NOTE: Prior to the presentation of these impressionistic charts, the child works with the Geography Classified Nomenclature to a certain point, covering some of the fundamental terminology. We begin the charts when his vocabulary is adequate. Then the presentations of the charts run parallel with his further work on the nomenclature. But it is always the terminology and concepts first which must be studied and then the presentation of the subsequent charts.

CHART 16a: The Position of the Earth in Regard to the Sun.

Sensorial aspect: When the earth moves around the sun it is not in a vertical position, but in an oblique position. It is slanted, inclined, always in the same direction. On the chart we see the two positions of the earth in regard to the sun.

Technical aspect: The Inclination of the Earth's Axis. The earth has two main movements: one around itself and another around the sun. We have seen the consequences of the first movement: day, night, the time zones. Now we must examine the consequences of the movement of the earth around the sun. One of the most important things to know about that movement is that the earth is not in a vertical position. If we unite the two poles with a straight line, that straight line will not be perpendicular to the plane of the ellipse around the sun. The earth does not describe a circular path around the sun, but an ellipse. Let's see how the earth's axis is in regard to the sun and to the plane of the ellipse.

Experiment II: 20 The Obliquity of the Polar Axis

When the position of the earth changes, the inclination remains the same--- always slightly to the north. A whole half of the earth is always lighted BUT not always the half-circle through the poles. When the earth is at the North and South points of its orbit, this half-circle of illumination does not go through the poles; when it is at the East and West points the illumination is the half of the earth the circle of which is described through the poles.

NOTE: This is an important experiment: the seasons as the consequense of revolution.

On the chart we see that the plane of the equator doesn't coincide with the plane of the orbit: it forms an angle of 23½° with it. As a consequence, when we have summer in the north, the sun's rays hit perpendicularly at an imaginary line which we call the Tropic of Cancer. When we have summer in the southern hemisphere, the sun's perpendicular rays hit another imaginary line called the Tropic of Capricorn.

CHART 15a The Seasons

Sensorial aspect: The conseugence of the earth's axis pointing towards the north is the seasons. How many seasons are there? Summer, autumn, winter, spring. On this chart, the sun is shown much smaller, but what is important is the position that the earth takes in relation to the sun. The line traces the path of the earth around the sun. We see four earths, but of course there is really only one. We have represented the earth in four main positions.

Technical aspect: Revolution and Its Consequences, or The Revolution of the Earth and the Resulting Seasons. When the North Pole is illuminated by the sun, it is summer for us. When it is not, it is winter for us. When one-half the North Pole and one-half the South Pole receive the sun's rays, it si spring or autumn. (SHOW Glove #2 with the axis inclined moving through the four positions.) The yellow part of the earth shows the illumined part. We can see on each of these earths the two tropics, the imaginary lines. These lines have been marked because it is at these two points where the sun's rays hit perpendicularly. We also have two more imaginary lines: the Arctic Circle and the Antarctic Circle. It is at these two imaginary lines that the sun's rays hit tangent to the earth at certain important times. These lines are important for the description of the seasons. (The rays hit tangentially at the arctic circle at the summer solstice; at the antarctic circle at the winter solstice.)

Experiment II: Marking Off the Imaginary Parallels

On the chart, following the earth's movement around the sun, we stop first at the date of March 21. This is the spring equinox. The earth is lighted exactly in half: the illuminated circle passes through the poles. (NOTE: We can show this movement with two children, one leaning backwards so that in the approach to the second child, the feet are closer to the second child than the head. As the first child passed by the side of the second, the feet and the head are at an equal distance from the second. Thus the spring equinox. Passing, the first child's head is now closer to the second. In drawing this position for the children, we can show the poles at a vertical line, demonstrated with the sun to the side, the exact half illumination.) On this day we will have 12 hours of day and 12 hours of night. "Equi" means "equal" and "nox" means "night." But the earth doesn't keep that position. It continues to move.

Days pass by and the conditions on the earth gradually change. We pass through the season of spring and the sun's heat moves north of the equator, going gradually further and further north until we come to June 21, the summer solstice. Here it is that the sun's rays hit perpendicularly at the Tropic of Cancer. We live in the Northern hemisphere, so it is summer. It is hot. The North Pole receives the sun's rays, the rays hitting at the tangent on the Arctic circle. The South Pole is dark. In the Northern hemisphere the days are longer and the nights are shorter, because the earth's parallels are no longer equally divided and lighted. Only the equator is divided in half and there the day and night is still of equal hours. The circle of illumination and the equator are the two maximum circles which cut each other in half. In the Northern hemisphere there are places where the sun never sets. It is at the Arctic circle, and thus we have the phenomenon of the Midnight Sun. At the South Pole there will be very long nights and almost no day. The sun never rises.

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The sun continues its trip, finally arriving at the autumn equinox, September 21. Here again the day is equal to the night. The circle of illumination passes through the poles and we have the same conditions as we had at the spring equinox. After September 23, the Tropic of Capricorn receives the perpendicular rays of the sun. The South Pole begins to receive light. For us winter is now coming. "Solstice" means "Sun stop," from the two parts of the word "sol" and "stice." Ancient people believed that the earth stopped for a few days. And, in fact, it seems that the earth remains in the same position for a few days because the sun's perpendicular rays must move up and down between the tropics.

Then we come to the winter solstice. The North Pole is dark; the South Pole receives the sun. For us night is longer than day. This is December 21, the shortest day of the year. At the South Pole they have long days and at the North Pole there is constant night.

Experiment II: 22. The Seasons

CHART 17: The Planisphere

Sensorial aspect: On the chart the equator is the line in the middle. The other two lines are the tropics. On both sides of the map are the most important dates of the earth's trips around the sun: the equinox and solstice dates. Thus we can note those dates when the sun's rays are perpendicular to the three lines.

Technical aspect: The First Day of Each Season. We know that the sun is still and that the earth moves around it. But on certain days the sun is closer to certain points on the earth. On March 21 and September 22 the sun is closer to the equator. On June 21, the sun is closer to the Tropic of Cancer. On December 22 it is closer to the Tropic of Capricorn.

CHART 18: The Distribution of the Heat on Earth

Sensorial aspect: On the earth there are hot zones and warm zones, depending on how the sun's rays hit the earth and according to the seasons. The red color on the chart indicates not weather; the green color indicates where the sun is not very hot; and there is much vegetation. The white is the color for the very cold zones, white representing ice.

Tecnhical aspect: The Astronomic Zones. The tropics and the polar circles divide the earth into 5 parts called astronomic zones. The TORRID ZONE is limited by the tropics and divided by the equator. It is the hottest part of the world and there are not very great temperature changes the year round. The green parts are the Northern Temperate Zone (between the Arctic Circle and the Tropic of Cancer) and the Southern Temperate Zone (included between the Antarctic Circle and the Tropic of Capricorn. Here we have temperate weather and much vegetation. The white areas are the coldest parts of the earth, mostly covered by ice. They are called the Frigid Zones.

CHARTS 1, 2, 3: displayed here together. In conjunction with these three charts, we present an exercise based on materials constructed on the plan of Chart 18;

a) A chart on which is shown an outline drawing of the globe (a circle) with the equator, tropics and circles lines shown. . .to mark the six zones.
b) Different colored cardboard parts which fit these zones: 1) green temperate zone-shaped piece which is spring, 2) brown temperate zone for autumn, 3) white temperate-zone for winter and 4)pink temperate zone for summer. THEN 5) two red pieces and one pink, each fitting one-half of the torrid zone to indicate the very hot areas near the equator. AND 6) two white and one blue pieces for the frigid zones. The blue is the extreme frigid, the polar winter. FINALLY 7) a sun.

Having displayed the three charts together, we introduce the above materials. And we review the names of the zones.

CHART 1: Our Summer

Sensorial aspect: When the sun sends its heat towards the northern part of the equator, it is summer for us. On the chart it shows the areas where it is the hottest during this period of the year.

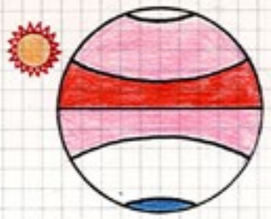
When the Sun is shining at the equator on September 21st, it is the Autumn Equinox, the beginning of Autumn in the Northern Hemisphere where we live (Brown). The Tropics are hot (Red) because the sun is shining directly over the equator. South of the tropics it is becoming Spring (Green). The Poles are equally frigid (White).

When the Sun shines directly on the Tropic of Cancer, it is the beginning of Summer for us in the northern Temperate Zone (Pink). It is the Summer Solstice on June 21st. In the Southern Temperate Zone it is Winter (White). The northern Tropic Zone is hotter (Red) than the Tropics south of the Equator (Pink). The North Pole is Frigid (white), but the South Pole is even colder (Blue).

Technical aspect: The Winter Solstice. On December 21st the sun's rays hit the

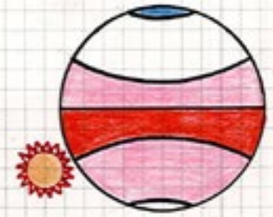
THE MOVEMENTS OF THE EARTH. . .
Chart 1. . .Sensorial

We can represent this with our materials:
The sun is at the level of the Tropic of Cancer: it is summer for us; but our summer is not very hot so we use the pink color. In the equatorial zone it is hot. Now it is the hottest to the north of the equator.
In the Southern temperate zone it is winter, so we use white. In the frigid zone it is always cold, but now the South Frigid zone is the coldest, so we have blue.



Technical aspect: The Summer Solstice. It is June 21 and we have said that the sun's rays heat the earth perpendicularly at the Tropic of Cancer. But the sun is only one of the factors which causes the variety of temperatures on the earth. There are other factors such as the wind and the mountains. But this chart shows us how the sun's heat is distributed.
Here we should point out the MAP'S CODE. The dark spots correspond to the Tropic of Cancer. The area on both sides of the tropics are hot, too. The blue area near the tropic of Cancer is cold because of the mountains located there. The temperate zones are warm to hot but never really hot in comparison with the Torrid zone.

CHART 2: Our Winter
Sensorial aspect: When the sun is at the Tropic of Capricorn, it is our winter. The chart shows us which are the cold and the very cold spots during this period of the year.
We can represent this on our chart, too: Here the sun is parallel to the Tropic of Capricorn.



Technical aspect: The Winter Solstice. On December 21st, the sun's rays hit the earth perpendicularly at the Tropic of Capricorn. Therefore, the hottest zones will be to the south. (Arranging the parts on our lined globe, we see this simply. On the chart we seek to give a more accurate concept) On the top of the chart is the code giving the meaning of the different colors. To the north of the Tropic of Cancer prevails the cold in blue colors. The hot areas are colored dark red---and most of them lie to the south, whereas in previous chart they were to the north of the equator.

CHART 3: Spring and Autumn
Sensorial aspect: This chart shows when the sun is in the position of the equinoxes (spring or autumn). (It would be better to have two charts; we have only one so there are no color differentiations) During spring and autumn the distribution of heat is fairly even. On the chart there are arrows which have nothing to do with spring or autumn---we consider them later in an explanation of the winds.

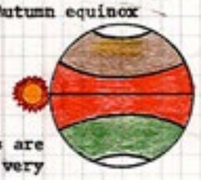
Technical aspect: The Equinoxes. On March 21 and September 21, the sun's rays hit the equator perpendicularly. The hot area zones are equally distributed to the north and the south of the equator. We examine each season separately, with our materials.

a) In the equatorial zone the heat is equally distributed to north and south of the equator.
b) Spring in the North temperate zone.
c) Autumn in the South temperate zone.
d) Frigid zones are cold, but not very very cold.

Spring equinox

a)Hot in the equatorial zone.
b) Autumn in the North temperate.
c) Spring in the South temperate.
d) The Frigid zones are cold, but not very very cold.

Autumn equinox



The child repeats the seasonal composition in further exercises, working on his own.

THE MOVEMENTS OF THE EARTH. . .

CHARTS 28, 29, 30: These charts, presented in display together, give, in a visual impression, the general indications of the diverse environments of the zones just considered. On each of the three charts, there is noted: 1) the primary races of peoples in that zone, 2) the most common foods; a picture often indicating also vegetation, 3) principle types of housing in the zone, and 4) principle types of materials used to make clothing. We must consider these charts as a point of departure for the children's further research. A particularly interesting aspect of these charts is that originally, to show the principle types of materials used for clothing, small pieces of the materials were attached to the charts---a good idea.

CHART 28: The Torrid Zone: The Environment.
Sensorial aspect. The Torrid zone is colored in red on the chart. The environment of the Torrid zone, as the environment of every zone, is composed of animals, plants and men. The greatest part of the peoples living in these zones are the Indian and African people. The people are primarily vegetarians, though we know certainly that many living in this zone also eat meat. On the chart we see fish, pigs and a palm tree, representing some of the primary food sources. We also note several interesting types of housing---that need updating. The types of material which are used for clothing are cotton, straw, silk.
Technical aspect: The Equatorial Climatic Zones. In the equatorial zone the vegetation is exhuberant: bananas, bamboo, palms and many other types of vegetation grow in abundance. The forest is so thick that it is almost impossible to go through it in many places. Farther away from the equator the vegetation is made primarily of many bushes---there are no longer the great trees. There are also areas where no vegetation grows at all and these are the deserts. In this zone there are animals of many kinds. Particularly in Africa we find many species: elephants, giraffs, hippopatamuses. Everywhere in this zone are found big reptiles. And many birds of different kinds with beautiful feathers. There are also many different kinds of fish.

CHART 29: The Temperate Zones: The Environment
Sensorial aspect: The North and South Temperate zones are colored in red. We have different pictures of the races, the houses, the food and clothing materials typical of these zones. The material used is cotton, flax (linen), fur or leather. The food shown is the cow, grapes, and grain.
Technical aspect: The Temperate Climatic Zones. In these zones grow trees that lose their leaves in autumn. In the colder zones and in the mountains grow trees which are evergreen. There is a great variety of plants in these two areas. But many of the plants have been taken by man to these zones, so that much of it is cultivated by man. The natural vegetation has been modified by man. At one time there were many different kinds of animals in these zones, but now they have almost disappeared: wolves, eagles, deer---man has almost killed them off. Now they are preserved only in zoological parks. Many animals in these zones have been domesticated by man: he uses them for work. Thus we have many cows, sheep, etc., whose numbers increase because man cares for them to use their products. (This is a good time to impress the fact that each animal has a real purposefulness in nature's plan.)

CHART 30: The Frigid Zones: The Environment
Sensorial aspect: There are two Frigid zones, but only the Northern zone is inhabited. Therefore it is shown in red. The Eskimos live in this zone. Their houses are made of packed snow and ice. They fish and hunt for food. Shown is the deer and the polar bear. The materials used for clothing are furs and skins.
Technical aspect: The Frigid Climatic Zones. Here the vegetation is scarce. And it grows only during the months when the ice melts. There are no big trees; mainly lichens and moss. Because the vegetation is scarce, there are also very few animals: only bears, deer, and wolves.

NOTE: In the presentation of these three charts, first we talk about the environment. Then we enrich the presentation with slides or books. Finally the children research the details. Thus the presentation can be extended to many areas of the children's interest. We can use the Fundamental Needs of Man work as a reference to guide a horizontal study of the way men have satisfied their needs in the past in a particular zone. Or we can make comparisons of the ways in which they satisfy their needs in different areas at one particular time.

RESEARCHES: A. The Cardinal Points
1) Location of the cardinal points in relation to the sun.
2) Use of the compass to locate cardinal points.
3) How to find the cardinal points without instruments during the day and the night.
4) Construction of a Sundial.

B. A graph of the different lengths of day and night throughout the year.
C. A graph showing the different temperatures during the day.
D. Time zones: Location of big cities in the world and marking the difference in time. . .between cities and the place where the child lives.
E. A collection of pictures of plants and animals living in the different Climatic zones.
F. How men satisfy their needs in different parts of the world. A horizontal research of the difference types of housing, materials used for clothing, nourishment at different points in time. Or comparisons of those ways between different groups at the same point in time.

THE ATMOSPHERE AND ITS PHENOMENA

The atmosphere protects the earth from too much heat or cold. It follows the earth in all of its movements and is subject to the force of gravity. It also exerts a certain pressure upon the earth. Even though it is not a liquid or a solid, as a gas it exerts a pressure upon the earth.

Experiments II: 23a, 23b, 23c: Air Pressure
(23_a: the pressure of the air is greater than the pressure of the water; so the small test tube goes on up inside the larger.)
The experiments have shown that there is a certain weight exerting pressure on the earth. This pressure isn't always the same. If measured at different points it differs according to the altitude and the temperature of the place.

The atmospheric pressure is measured with a barometer. This barometer is made of a mercury bar which goes up and down according to the atmospheric pressure. So with the difference of pressure at different parts of the earth, there are movements of the air. The air movements caused by the variation of pressure are called wind. The atmosphere of the earth is very important. Life would be impossible without it. The different pressures bring cold air to the hot places and warm air to the cold ones. How do the winds form?

CHART 24a: Winds: Why They Form.

Sensorial aspect: On the chart the earth is represented by a half circle---half the earth. The poles are marked at the North with an eskimo and at the South by a penguin. The highest point, then, represents the equatorial zone. The red areas denote hot air; the blue is cold air. The chart does not show four different earths, but four different passages of that air.

Technical aspect: The Formation of the Winds. Winds are caused by different air pressures. If it is very hot at a certain point on earth---the sun shines on the air, the air heats and goes up. At this point on earth, the pressure is low. There is low pressure because the hot air expands and rises, thus exerting a lower pressure on the earth.

No space can remain empty. The cold air comes into that space left by the warm air. The cold air comes from those areas where the pressure is greater. How is this phenomena represented? On the first picture, the sun is sending rays perpendicularly to the equatorial zones. This area, then, is very hot and the air rises. The red arrows are going up. In the second picture, the cold air comes from the poles to fill in the empty space. When the cold air reaches the equator, it rises. Thus we have two phenomena in constant motion. (We make the explanation from the beginning of the phenomenon, the air rising) The cold air, the, as it heats and rises, pushes to the side, towards the poles, the warm air that was there. So the hot air (in picture 3) that rose from the equatorial zone moves towards the poles, cools, becomes heavy and goes down. In the fourth picture we see the complete circulation movement.

Where it is hot, the air is heated and rises and we have areas of low pressure. Where it is cold and coming down we have high pressure. So we have air currents running close to the earth and some running high above the earth.

In reality, it is not quite that simple!

CHART 25a Low and High Pressure

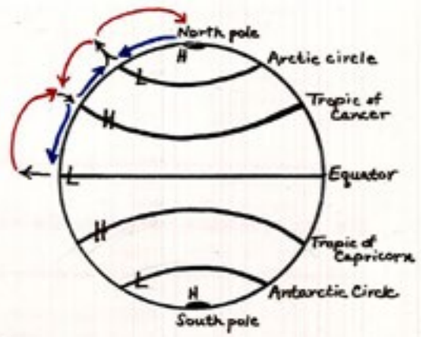
Sensorial aspect: The hot air is still shown with red---dots and arrows. The blue is cold. The earth is only a circle (cut in half) and the equator is marked with a red line.

Technical aspect: Winds: The Scheme of their Formation. When the air is hot, it expands and rises. When it is cold, it becomes heavy and comes down. The chart shows the complete cycle of the air around the earth. The hot air is heated, it rises, moves toward the poles. Thus we have four currents showing that movement. In truth, there are an infinite number of currents in such motion around the sphere. There are two kinds of winds: regular winds which blow in regular patterns; and irregular winds which blow without a pattern. First we discuss regular winds.

CHART 26a: Regular Winds

Sensorial aspect: Here the earth is represented with a circle. Lines mark the tropics, the equator, the poles. (The chart omits the cold air current originating at the poles. And it shows the winds as affected by the earth's rotation. Therefore, the chart itself is complex and difficult to comprehend all at once. It warrants a blackboard illustration as follows: first showing the lines, then drawing the currents as they are explained. Only the first quarter of currents is shown. The diagram can subsequently be completed and then compared to the chart itself.)

The air above the equator is heated and rises. This causes the colder air to come from the tropics; and when it reaches a high level, this newly heated air pushes the warm air towards the tropics that was already there. This air, from the equator to the tropics, then goes up, cools, comes down--- end of cycle. The hot air at the equator is very humid. As it moves towards the topics, it cools and we have equatorial rains.



Some of the air pushed up at the equator continues on towards the arctic zone. Meantime, cold masses of air are moving towards the equatorial zone from the poles at a very low altitude because the air is so heavy. This cold mass of air moving towards the equator collides with the air current coming from the equator which has cooled at the tropics and dropped. The result is a current which rises at the arctic circle. (Currents which rise : updrafts)
On the chart the rotation of the earth is considered. The arrows are inclined to show the inclination from the West to the East.

Technical aspect: Big Systems of Regular Winds: Zones of High and Low Pressure. These cycles of air create areas of high and low pressure. (Some of the air from the equator doesn't lose its altitude until it is above the poles; then it drops, pushing the air towards the polar circle.) The poles and the tropics are the places where the air comes down: areas of high pressure. The equator and the polar regions, where the air rises, are the areas of low pressure.

When the wind rises vertically, we cannot feel it. So these zones are called calm zones, . . .the Arctics and the Equator. They are also called cyclonic zones because in these areas of low pressure, there are often tempests, heavy rains, bad weather. In the areas of high pressure (Tropics and the Poles) good weather prevails and they are called anti-cyclonic zones.

CHARTS 27a, 28a (presented together) Local Winds

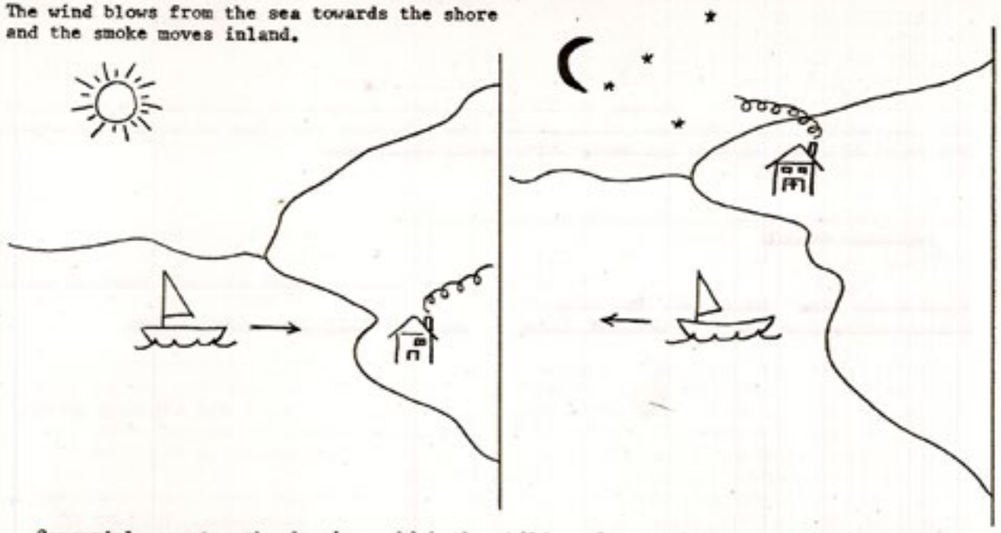
CHART 27a: Winds by the Sea

Sensorial aspect: (children can make the drawings). It's daytime. The sun shines. The earth is heated and the water is heated. But the land heats before the water.

It's nighttime. The fisherman goes out and the wind pushes him out to sea. The smoke blows out to sea, too.

THE ATMOSPHERE AND ITS PHENOMENA. . .

The wind blows from the sea towards the shore and the smoke moves inland.



Sensorial aspect: the drawings which the children do, as shown, are more interesting for them than the initial presentation of the completed charts. With these drawings they meet the concepts simply. Then we present the more complicated pictorial representation. The wind from the sea is called the sea breeze. The wind from the land is called the land breeze.

Experiment II: 24a: The Rapidity of Cooling Depends on the Nature of the Body

Technical aspect: Local Winds: The Sea Breeze; the Land Breeze. With the experiment, we have verified that the land is heated more quickly than the water and the water more slowly. But. . .the water retains the heat longer than the land, which loses the heat more quickly. Warm air is lighter than cold air. And we know that no space remains empty. So what happens in reality? During the daytime the land heats more quickly. So the air over the land is heated, becomes lighter, rises; and thus is determined an empty space which is filled in by the cooler air coming in from the sea. So in the day we have "sea breeze." At night we have the opposite phenomena. The water is heated slower, but it retains the heat longer. The air over the land gets colder quicker. As the water is warm, the air above the water is warmed, it rises and the cold air from the land moves over the sea to fill that space---so we have the "land breeze."

CHART 3, CHART 4, CHART 5 (shown together)

Sensorial aspect (of all three): Wind and Rain. These charts show how winds change their course during the different parts of the year. They also help explain the relationship which exists between wind and rain. The blue arrows stand for the steady winds. The red ones for the irregular winds. Special winds are shown on charts #4 and #5: called monsoon winds. NOTE: Here we would consider specifically the types of winds that blow in our own locale.) The parts in orange indicate the dry zones where there is very little rain. The light and dark blue parts indicate the areas where there is a great deal of rain.

CHART 3: Winds and Their Direction During the Equinox

Technical aspect: The sun shows the equinox of spring or autumn: it is at the equator. When the sun is in this position, the winds are more regular. During this time there is an exchange of air masses (regular winds) between the tropics and the equator due to the sun's position. There are other irregular winds, many of which would not fit on our chart. The red arrows on the chart indicate a variety of other winds. Breezes change direction day and night; mountains interfere with their course and there are many other factors, too. The steady winds which blow between the tropics and the equator are called the trade winds. The name trade wind originzted in the days of sail, when these steady winds were mainstays of ocean commerce.

THE ATMOSPHERE AND ITS PHENOMENA. . .

Chart 3.4.5. . ,

CHART 4: Winds and the Distribution of Precipitation

Technical aspect: The chart shows the sun hitting the Tropic of Cancer. It is hotter in the northern hemisphere because the sun is sending more heat to the north of the equator; and thus changes in the winds are provoked. Some winds actually change as a result of the seasons. An example is the monsoon winds, which blow particularly in the area of the Indian Ocean. During the summer the land becomes hot and requires cooler air from the water. The wind which blows toward the land from the water is heavy with moisture and so as it blows in over the land, the monsoon rains come. So we see that India is dark blue, indicating much precipitation.

CHART 5: Winds and the Distribution of Precipitation

Technical aspect: During the winter in the northern hemisphere, the sun is at the Tropic of Carpricorn. It is summer in the southern hemisphere. The water heats slower, but retains the heat while the earth cools. So the monsoon winds now blow from the land towards the sea. And in all this area (note India again on the chart) there are many arid regions, deserts. The monsoon winds are only one example of local winds.

EXERCISE: Using the blank globe material on which only the imaginary lines are shown (that one used to construct the changing temperatures of the seasons) and the sun from that same material, the child reconstructs wind patterns with small red and blue arrows. (Should be kept in a special separate box.) With these arrows, he may show winds such as the monsoon winds in summer and then in winter, moving the sun as an indicator. He can also construct the patterns of other local winds.

Each time he completes a pattern, he copies it on a world map (need blank world map forms), positioning the arrows as he has shown them with the materials. This design provides a reference for him for the difference patterns of the winds and currents.

RESEARCHES:

A. Practical experiences which show that air occupies space.
B. Practical experiences with the movements of the earth.
C. The observation and construction of a barometer.
D. The child records difference pressures of different altitudes during an outing.
E. Records different pressures of the day and night at the same place on the earth, and constructs a graph to show the comparison.
F. Construction of apparatus used to show the direction of the wind.
G. Construction of an instrument to measure wind speeds.
H. Research on local winds: Why do they form?
In what direction do they blow?
What changes do they undergo?
What phenomena do they provoke?

The Work of the Wind : CHAPTER V

There are many actions of the wind in nature. It contributes to the destruction of rock, it transports material which accumulates on the ground. It brings changes in the climate. It contributes to the distribution of pollen and to the diffusion of seeds of many plants. It also gives to man great mechanic force with which he moves his machines. In many cases, man must actually rely on the performance of the wind. To some extent, winds provoke waves and marine currents. Marine currents are great masses of water which, like rivers, go from one place to another in the oceans. Marine currents, then, are partly caused by the winds. (and partly caused by internal phenomena: different density, different temperatures.)

Two Additional Experiments:
1) Boil water until only the calcium deposit remains. It is more concentrated in a smaller volume.
2) Take a pyrex, fill it with water and wood shavings. Heat. First the sawdust will be at the bottom, then it goes up and the cold water goes down.

NOTE: The calm band without wind at the equator is called doldrums.

There are both internal and external causes for the marine currents. The internal causes are temperature and density; the external causes are the wind and the rotation of the earth. The winds push the water in the direction that they blow.

Experiment II: 25 Origin of Marine Currents

The experiment does not reproduce the actual situation. In the experiment, the cold water sinks, the warm goes up towards the surface. What really happens in the oceans is the opposite phenomenon: during the day the sun heats the surface of the water, thus evaporating many water molecules. This evaporation of a liquid uses heat, so the water molecules at the surface cool and the density increases. Then it sinks. So here the warmer water is moving down.

The experiment shows the vertical current. In fact, there are both vertical and horizontal currents. The vertical currents are formed by the exchange of the surface water and deep water. The horizontal currents are movements as a result of the wind or rotation: they can occur at the surface or in the depths.

We can compare the way of the waters with the way the wind behaves. In the water there are formed many circles or currents which exchange water from the cold countries with that of the warm countries, thus favorably affecting the climate.

CHARTS 9 and 10: Marine Currents

Sensorial aspect: Both charts show us in a systematic way the superficial movements of the ocean. The blue arrows show the cold currents; the red arrows the warm currents. Chart #9 shows how currents change their course when they meet the coasts of continents: when they hit the coast, they begin to follow it. The currents have good influence on climates, because warm currents reach very cold parts of the earth where they cool and return to warm coasts, bringing cool water.

We could also compare the movements of currents to the circulation of blood in our bodies. Blood is purified in our lungs; then it travels throughout the body; and finally returns again to be purified. (In the oceans, the great purifier is the coral island: see Montessori: From Childhood to Adolescence) Thus the blood travels in a closed cycle which is beneficial to the whole body. In the same way the marine current distributes warm water to the cold regions, then returns to be warmed again; and in so doing, it serves its cosmic duty.

Chart 9: Technical aspect: Warm and Cold Marine Currents. The polar winds from the south create a marine current which goes along the Antarctic Ocean. This current meets the south end of Africa, Australia, and South America. Each time it meets a continent, the current is split, part of it traveling north along the continent's coast.

The currents indicated by the red arrows are caused by equatorial winds, warm currents. Most important for Europe is that current which originates in the Gulf of Mexico (Gulf Stream Current): it crosses the Atlantic Ocean and moves around the northern European coast (Norway). Another important current begins in Japan, crosses the Pacific and flows along the coasts of North America to Alaska: the Kuroshio Current or the Black Current. Only a few currents are marked on this chart. There are many more.

Chart 10: Technical aspect: Marine Currents: Nomenclature. Here are marked a greater number of currents. We see here how complex the marine currents are. On this map the currents are marked, the paths are shown and also the names are given. (The chart is not, however, used for the memorization of names. With the child we simply read them and analyze them as warm or cold, direction in which the current flows, which parts of the world it touches: Where does it deviate? Which coasts does it follow?)

Another effect of the wind is the waves. Waves are oscillations of water drops. The length and force of the waves is determined by the wind. The waves follow the direction of the wind: the length depends on the strength of the wind. The sea water contains many suspended substances: sand, salt, pebbles, etc. The waves are

sent by the wind towards the beaches, the shore---and this water is an erosive force which gradually destroys the shores. The erosive power of the waves is increased by the pebbles and sand and other materials floating in the water. The water by itself erodes the rock and sand, but when the water contains all this matter, the erosive power increases.

CHART 11: Let's Destroy the Rock

Sensorial aspect: Some children are playing with guns. They are pointing the guns toward the rock, and they chip it away with their bullets.

Technical aspect: The Erosive Power of the Wind. We have said that the wind provokes the waves, and that the waves together with the floating matter destroy the cliffs, the shores, etc. So the waves are a result of the wind. But the wind itself can destroy the rock. The wind may contain sand and dust and other particles (sand storms); and when it blows against rock, it erodes it because of those many particles.

The effect is more outstanding when the wind blows always in the same direction. And when the wind hits rocks which are less solid. In nature there are many strange phenomena of erosion. In one rock there might be softer and more solid parts. Thus there are rocks which wear away within until only a bridge is left. Some rocks wear away, taking on various shapes such as those of animals.

The erosion of the wind is stronger in arid regions where there is little rain. In some dry lands, the wind takes off whole layers of land, leaving exposed the very old ones. In the desert, the wind transports whole hills of sand, thus constantly changing the terrain, the scenery of the desert.

Experiment II: 26b: The Stratification of Rocks
(linked to experiment 13a: the stratification of rocks)
26b: The Wearing Away of Stratified Sediments

Sometimes the wind combines with water to produce a chemical change in addition to the physical. The physical work of the wind is the waves, the currents. The chemical work is when the water and the wind transform rock into new substances, or other matter: water and wind RUST metals.

Researches

A. Practical verification of the reality of currents. (rip tide: undertow)
B. Research of news about main currents: pictures, post cards of places where currents flow to show what their influence on the environment is.
C. Research of rocks which show the erosive work of wind or water. (pictures or actual rocks.)
D. Research of other actions of wind in nature.

CHAPTER VI. THE HYDROPHERE AND ITS PHENOMENA

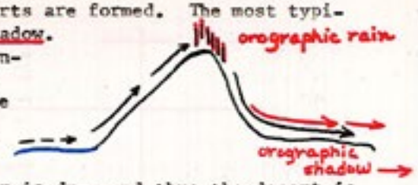
Man, in order to live, needs water. Also the animals and plants need water to survive. Water has always played an important role. Water has always been a great factor in the evolution of the earth and the evolution of living beings. Life began in water. . .and life developed in water for a long time. Then these living beings were able to abandon water and live outside it, but still they had need of water in order to sustain life. All bodies are formed, in great part, of water. Three-fourths of the earth is covered by water. Water also reaches the earth in the form of rain. The water which first filled in the lowlands formed by the volcanoes was rainwater, and thus life was made possible. How is the rain formed? We will discover that it does not rain in the same way in all parts of the earth. There are many different causes of this precipitation.

CHART 23a: How the Rains Form

Sensorial aspect: Rain: Its Formation. The air is represented by strata of different shades of color. The gradually lighter shades of red indicate that the higher we go, the cooler the air becomes. The bottom of the mountain indicates sea level. The arrows indicate air, full of humidity, traveling upwards.

Technical aspect: Consequences of this Kind of Rain: Deserts. During the daytime when the sun shines at sea level it is heated, full of humidity and it begins to rise. But this humidified air, as it rises, hits the cold strata of air and cools. The humidity condenses. And it rains. So in the mountains it rains more often than on

THE plains. This is one of the reasons why the deserts are formed. The most typical phenomena of the desert is the "orographical" shadow. The humid air rises up, from the sea, up the mountainside. It is hot. But, reaching a certain level of cold strata, it cools and it rains in the area of the mountain top. The rain formed by the condensation of the sea air rising provokes the phenomena of the "orographical" shadow. The result is desert.



The air continues in its direction but by now the air is dry; and thus the desert is formed. It rains where warm air meets cold air. So when we have mountain ranges, we have areas close by where it seldom rains. When there are constant winds blowing towards the mountain, the situation of much rain on one side of the mountain and little on the other is exaggerated; in the absence of such winds, the situation is not so characteristic.

CHART 6: Rain at Sea

Sensorial aspect: The chart shows that it is not always necessary to have a mountain for rain to form. There are other reasons: some environmental situations that produce rain are high coasts.

Technical aspect: Local Rain. In the same way there are local winds, there are local rains, provoked by local winds. When the wind blows from the sea, bringing warm air rich in humidity; and the coast is high, the coast obliges the wind to go up. At a certain point the humid air condenses at a cooler altitude and it starts to rain.

CHARTS 7 & 8: Presented Together

CHART 7: Warm Air Rises : Evaporation

Sensorial aspect: Here we have an equatorial scene, with exhuberant vegetation which is characteristic of the equator. The spirals indicate the warm air, full of humidity, which rises.

Technical aspect: Evaporation. During the daytime, the sun heats the land and the water. The water evaporates, but the air above the land heats faster than the air above the water. As the warm air rises, the humid air above water comes in to fill the empty space.

CHART 8: Vapor Condenses

Sensorial aspect: The scenery is the same, but there are clouds and it rains. Why does it rain so often?

Technical aspect: Condensation. We have already said that the warm air above the water moves towards the land because that air has heated faster. Once it gets above the land, it is heated again and rises. But this new air is full of humidity from the sea. When that air reaches a certain altitude, the vapor condenses and rain falls. These are called "periodical" rains because they usually fall at about three o'clock in the afternoon. But the water that reaches the earth can be also in the form of SNOW, FOG, HAIL, DEW, FROST, . .(Explain the difference between these phenomena and how they are formed.) When the rain reaches the earth it is absorbed by the land. . . .

Part of the rain falls on mountaintops, as we have seen, and it begins to travel down the slopes of the mountains. It starts running into small rivers, then larger ones until we have a full current. We are especially interested in rivers because they have always been an important part of man's history. Rivers are fresh water courses which flow by a natural channel, being confined within banks, into a lake, into another river, or into the sea. Fossils of primitive man have always been found along the banks of the great rivers. It was a place where primitive man might find animals which he needed to sustain his life. Rivers have always been essential to both the hunter and the farmer; both hunting and agriculture depend on the animals which need the water, and rivers are important, too, in the growing of crops. Man also finds fish in the waters (those still unpoluted are abundant with fish.)

And so main civilizations have always developed along the great rivers, or close to good sources of water. And for a long time rivers were also the easiest and shortest way of communication. Man even made artificial rivers to meet their needs. Factories now are located near rivers for the purposes of communication and transportation.

CHART 12: Most Important Rivers

Sensorial aspect: The chart shows the most important rivers which cross the earth. There are many others. The earth is colored light green, dark green, brown and yellow.

Technical aspect: The Formation of Rivers. Here we show the river which runs down the slopes of the mountains, becoming a larger and larger river. That part of the rainwater which is not absorbed by the land continues as part of the river; and the water course runs continually. Rivers are thus started in the highest parts of the earth and flow down. Rivers originate in different ways: a spring, a melting glacier of ice, a lake or pool. The dark brown on the chart represents the highest parts of the earth. The yellow are high areas, but lower than those in brown. The light green are the lower lands, the plains. The dark green is the land at sea level. Following the courses of many rivers, then, we see that the river's path crosses the land shown in all the different colors.

CHART 13, 14, and 15: The Earth as a Sponge

These three charts show the different rivers in Europe and in the world. All the rivers which cross the land make it look like a big sponge.

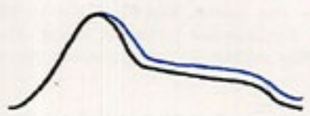
CHART 13: Technical aspect: The Main Rivers of Europe. Here those main rivers are marked.

CHART 14: Technical aspect: The Rivers of Europe. Here are all the rivers in Europe. We want to call the child's attention to the NUMBER of rivers in the world. We talk about only a few, but it is important to realize the vast number which exist on our earth.

CHART 15: Great Rivers of the World. Here again we show only the most important rivers. Our discussion centers now around the importance of rivers for life; and how the rivers on which we all depend are distributed throughout the world.

A short history of the river is given after the importance of rivers is emphasized. We may think that the life of a river is external, but instead the history of a river is like the history of man and civilization: the river has an infancy, a youth, an adulthood and an old age.

The infant river is small, short and has much energy. We call this river a stream. It runs down a steep slope and tends to take with it everything that it finds in its way. It runs down a slope and quickly reaches the sea or a lake. As the infant river runs, it continually brings with it rocks, sand, etc. . . and gradually the course of the river becomes calmer.



Instead of continuing as steeply as before, the stream bed becomes flatter. The infant river has become a youth. It still runs quickly, but not as fast as before. It is still full of energy, still bringing with it a great quantity of matter. At this point the river is not good for navigation.

Then the river reaches maturity, adulthood. At this point the river is good for navigation. The course is smooth, there is much water (deep) and it is very wide. Now it comes down a very slight inclination, but it continues to bring down great quantities of matter.

Finally the river becomes old. It goes very slowly; it is tired. Its surface is very smooth. And because the river is tired and not very strong, when it finds an obstacle, instead of jumping over it, it goes around it.

We see in the drawings that each time the river bed flattens out, the mountain gets shorter: the water has worn away much of the rock and soil and sand that contributes to the mountain's slopes.

Looking at an old river from an overhead view, we see a winding course; these curves are called a meander. An old river is not good for navigation in many parts because often sand banks form on the river bottom. The river is not strong enough now to demolish the accumulating piles of matter which it has transported. When the river is about to die, the water becomes almost stagnant, lacking the strength to reach the ocean.

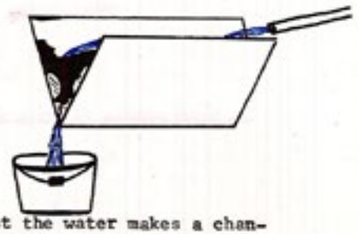
The young river carries great amounts of matter with it. All this matter is brought down and contributes to the erosive work of the water. The chart shows this erosive effect:

CHART 16: The Work of the Water

Sensorial aspect: On the chart we see men using picks to excavate the bottom and sides of the river. Other men are carrying away the removed material in baskets.

Technical aspect: The Erosive Work of Water: The stream takes with it quantities of different materials: sand, rocks, etc. The water draws this matter along its bed. So this matter is the instrument of the river, contributing its own erosive power as it it carried along by the water. On the chart it is represented by the men's picks. This erosive work is greater when it rains because of the increased height of the water and the subsequently greater f orce.

An Experiment: Using two sheets of tin, or a similar material, prepare a V-shaped basin. Line it with rocks and pebbles along both sides and the bottom: a small scale Grand Canyon. Fill in all the empty space with sand so that the basin appears to be completely filled with sand. (The children's surprise) At the lower edge of one of the open sides, place a bucket to catch the sand and water that runs off. At the opposite end, top, open a hose that runs ACROSS THE TOP OF THE SAND, as a river. At first the water makes a channel, then it widens and deepens until all the sand is removed and the rocks are left. This is the work that a river does over a long period of time. (Best to do this experiment out in the garden!)



In this way rivers form valleys---usually V-shaped.

CHART 17: The Valley Excavated by a River

Sensorial aspect: If we could cut our river valley like this (cross-section), we would see that it has a "V" shape.

Technical aspect: The Fluvial Valley: The erosive work of the river is concentrated above all at the center of the river bed, that point where the current runs faster. Along the banks the current is generally slower; at the center faster. So valleys formed by rivers often have a V-shape. However, because most rivers have many tributaries whose valley patterns intrude on the main river valley, this central valley is cut by many others; and thus there are few perfect V- shapes.

When the river stops digging so deeply, when it is becoming old and the valley stops enlarging, the river bed ceases to deepen and the excavation at the bottom stops.

In addition to the work of excavation, the river also does the work of depositing this matter that it has excavated. The river excavates from the mountain and deposits the matter on the plain. Many plains have a fluvial origin, formed by matter brought by the rivers.

The erosive work of the river is greatest at the center. But there are other points where the erosive work is even greater: one of these is the falls. In the case of a falls, the water comes down with great force, excavating a hole at the base. As a result of this hole that deepens at the base, the rocks and earth just above the base begin to crumble and fall. Thus the falls are never still, but always moving backwards.

It is reported that Niagara Falls moves backwards approximately 60 cm. per year. (Walter reports that geologists have actually dammed the Niagara River to study this rock erosion, measuring the position of the falls; and at a certain point in the future will again repeat this measurement to determine more exactly the wearing-away process and its rate.)

So the first point of erosion in the falls is that point where the water falls at the base. The second point is above the hole that this erosion makes where the edge turns. Finally, there is erosion at the upper angle, the rock edge where the falls originate. When the fall is young, this point is very sharp. As the falls age, this angle becomes smoother, more rounded. And this "rounding off" becomes finally a new rock formation over which the water runs with great speed and we call this rapids.

CHART 18: A Valley Excavated by a River

Sensorial: We see pictured here a narrow deep valley with almost vertical walls. How is the valley formed?

Technical aspect: The Canyon: Some water streams run across regions with a very dry climate. Therefore, the river does not have any tributaries. In this way one single valley is formed, and the river digs the valley always deeper, especially when there are no rocks, where the land is dry and breaks up very easily. On the chart we see a very dry climate with almost no vegetation: therefore, the erosive work is not hindered at all. With time the water digs a very deep valley with vertical walls.

At this point, we note the importance of plants and trees to prevent erosion. At the beginning of the earth the erosive force was very strong because there were no plants. In more recent times, water still carries away whole parts of land where there is a lack of trees and plants to hold the earth. The slopes of the mountains (The Alpimmini) of central Italy show the effects of this massive erosion. This erosive work which takes place where there is no vegetation is not only the work of the river, but the work of water in general. Rainwater, before it reaches the rivers, moves whole areas of land in the phenomenon of landslides.

CHART 19: The Mushroom

Sensorial aspect: Rainwater often provokes strange erosive phenomena. On the chart the rainwater has taken all the land away from this rock formation, leaving only a stack of rocks resembling a pillar or an umbrella.

Technical aspect: The Earth Pillar: How Is This Formed? Originally the land is flat: we have the slope of a mountain. Down the surface runs water. However, under the soil there was a rock. The water at a certain point in carrying the dirt away, meets the rock and starts running around it. As water tends to follow the same road, when it rains the water continues to follow the channel it has made. At a certain point all the ground around the rock is taken away, but the rock, which is very heavy, remains. Finally the entire pillar is revealed.

Not all the rainwater runs down across the surface or the land; some is absorbed into the ground. Often this water comes back to the surface of the earth as a spring because water seeks its own level.

Experiment: Water Seeks its Own Level: A simple experiment with different shaped test tubes as used in First Level Experiments: #13, to show this phenomenon.

Underground the water goes on with its work. It excavates underground caves. Due to the erosive work of water which is both mechanical and chemical, the water, containing CO_2, dissolves the rock

Experiment 28: Destruction of the Rock: A relatively dangerous experiment which the teacher must supervise. Here we take a piece of rock (marble) and let some drops of hydrochloric acid drop on the rock. The acid makes a foam which eats a hole in the rock. However, it is not actually this acid which does this work.

Often the caves excavated underground are very beautiful and interesting due to the formation of stalagmites and stalagtites. (In further research, the children can investigate these formations, the colors, how they are formed.) If the underground water runs through mineral substances, we have the origin of the mineral and thermal waters.

CHART 20 and 21: Like a Young Boy

Sensorial aspect (of both): We have said that water penetrates into the ground, digging tunnels and caves and then finally emerging, often as a spring. The water is like a boy who likes to sit in a favorite place reading a book. Perhaps a hidden place. After awhile he becomes tired, he stretches and puts his book aside. He gets comfortable, stretching out into the open.

Technical aspect: 20:Freeze 21:Thaw, . .When the water fills in the openings of the rocks, it remains there, comfortably resting. Then, when winter comes, that water freezes. When water passes from liquid to solid, it grows and expands. When it freezes and expands, we do not notice the splitting of the rocks or the cracking because the ice acts as a cement. But in the spring, when the temperature increases, the ice melts and turns to water. The ice no longer keeps the rocks together and the result is rocks breaking loose, landslides, etc. This is the result of the ice expansion which has altered and broken up the rocks from within.

Experiment 32A (II): Expansion — Water is the only liquid which expands when in a solid state.

We are considering water as a solid, not as rain. What is the phenomenon produced by water in a solid state? In the coldest regions, rainwater falls as snow. Snow, if it doesn't melt, accumulates in basins or valleys as nève and forms blocks of ice. The blocks of ice, when they come to a slope, slide down. When those blocks of ice come down to a certain height, they begin to melt. A glacier is called a "river of ice;" it is frozen water that moves.

Snow accumulates in the "collective basin." The snow, even though it is soft, because of its weight, becomes packed ice. The snow finds a slope; and the surface snowfield begins to start sliding down. The parts underneath remain to become a permanent glacier.

CHART 24: The Valley Excavated by a Glacier

Sensorial aspect: Glaciers move. They have great power because of their weight. They excavate valleys, but not as a river; they excavate both the depth and the sides.

Technical aspect: If we could cut a glacial valley, we would see that it has a U-shape. The glacier, with the materials it carries along with it, excavates at the center and on both sides.

CHART 22: The Glacier and the Environment

Sensorial aspect: These are very high mountains. At the bottom the glacier melts and the running stream begins. Here the temperature is warmer and we see a house in the lower valley. Above there is snow and ice all year round.

Technical aspect: Moraines. The typical desposits left behind by the glacier are called moraines. The glacier brings with it small and large rocks that it abandons along the way. On the chart we see lateral moraines along the sides. Frontal or terminal moraines show where the glacier once moved farther forward and when it melted and receded, it left behind the moraines. When two glaciers meet, medial moraines are formed.

CHART 23: What the Valley Looks Like when the Glacier Disappears

Sensorial aspect: During the history of the earth, there have been very cold and very warm periods. In the warm periods many glaciers disappeared. This is how the landscape looks when the glacier disappears. There is a deep valley (the glacier digs very deeply). The walls of the valley are very smooth and rounded; there are no rocks sticking out. At the bottom are the rocks and stones that the glacier carried down with it. Usually a river runs through the valley.

Technical aspect: The Hanging Valleys. These valleys start with a water fall high up in the mountains.

The Constant Work of the Water

CHARTS 25 and 26 (26: Sensorial; and 25: Technical) The Cycle of Water.

Technical aspect (25): The Cycle of Water. Water from the sea (or ocean or lake, etc.) evaporates, rises. This evaporation is always taking place, but the rate increases with much sun. Water vapor goes up and forms the clouds. The clouds are pushed by the wind across the sky. When they come to a place where the temperature is colder, the vapor transforms and falls to the earth as snow, rain, hail, etc. Thus the water has come to the earth, nourishing the rivers which carry the water to the lakes and seas. In this way we have a complete cycle.

Sensorial aspect (26): Dr. Montessori represented the water cycle as The Game of the Water. She says: Water is like children who like to climb, to run, to slide and then to start all over again. The children, then, are the water. Part of the children will always like to hide in a cave. On the chart we see some of them in a cave indicating the underground water. But both the water and the children eventually come out---to the surface.

CHART 27: Water and Plants

Sensorial aspect: We have talked of the water as rivers and glaciers. Here we have the relationship of water and life. Water is the benefactor of all living beings. We have seen that plants and animals cannot live without it. Without water, nothing can grow. Through symbolic colors, we see that in different parts of the world, we have different types of vegetation.

Technical aspect: Types of Vegetation. The chart shows yellow areas: these are the areas where no vegetation grows, particularly the deserts. The dark green parts shown are those where it is very hot, but there is also much water. Here forests grow with exhuberant vegetation. The areas colored in light green are those where it is hot, but there is less water, so there is less abundant vegetation: these are often the plains. The brown-orange areas represent those "temperate zones." These areas have temperate climates. There is not much water but plants do not need it because the heat is not great. These areas have been greatly transformed by men; man has paved away many plants; cemented the vegetation. Farther north we see an area of black pine trees. These are very cold areas where only coniferous trees grow. Needles of the evergreen are protected against the cold. Above them are green pine trees. Here is the coldest part of the earth. Very few species of plant life grow here, only the moss and lichens.

NOTE: We can present this chart as a static material or as a dynamic starting point for research.

Researches

A. The Importance of Water for Life:
   1) The phenomena of pollution. How can we help to diminish the pollution that the progress of civilization has brought?
B. Rain, Snow, Hail, dew, frost, fog, sleet, etc. . . .: observations drawings, researches.
C. Research and illustrations of the Life of a River
D. Changes made in the environment by a river.
E. Outings: to a river, etc. . . .
F. The Mechanical and Chemical Action of the Water: news and illustrations.
G. The Glacier:
   1) Illustrations of changes in the environment due to glaciers.
   2) Collections of maps showing the location of glaciers on earth during different geological periods.
H. Research of the Different Kinds of Vegetation and how they are distributed on the earth.

Geography never ends. Live in your own times, following Montessori's principles, keeping that which is fundamental, but changing the text to meet the children's need for adaptation to a world that is always a new body of information as man begins to understand it.

--- Santina

esercizio	- Cartellone muto con frecce mobili per lo studio dei venti Blank chart with movable arrows for the study of winds	-
-	V. AZIONE EOLICA (IL LAVORO DEL VENTO) THE WORK OF THE WIND	-
35° esp.	- Origine delle correnti marine Origin of marine currents	A25
37° cart.	- Correnti marine: calde e fredde The marine currents: warm and cold	9
38° cart.	- Correnti marine: nomenclatura e direzioni The nomenclature and direction of the marine currents	10
39° cart.	- Potere erosivo del vento The erosive powers of the wind	11
36° esp.	- Stratificazione delle rocce The stratification of rocks	A26
-	VI. IDROSFERA E SUOI FENOMENI THE HYDROSPHERE AND ITS PHENOMENA	-
40° cart.	- Pioggia: sua formazione (Perchè piove) Rain: its formation (Why it rains?)	23a
41° cart.	- Piogge locali Local rain	6
42° cart.	- Evaporazione (L'aria calda sale) Evaporation (Warm air rises)	7
43° cart.	- Condensazione (Il vapore si condensa) The condensation of the vapors	8
44° cart.	- Formazione dei fiumi The formation of rivers	12
45° cart.	- Principali fiumi d' Europa The principal rivers of Europe	13
46° cart.	- Fiumi d' Europa The rivers of Europe	14
47° cart.	- Principali fiumi del mondo The principal rivers of the world	15
48° cart.	- Azione erosiva dell'acqua (Il lavoro dell'acqua) The erosive action of water (The work of the water)	16
49° cart.	- Valle fluviale The fluvial valley	17
50° cart.	- Canon The canyon	18

51° cart.	- "Piramidi di terra" "The earth pillar"	19
37° esp.	- Distruzione della roccia Destruction of the rocks	A28
52° cart.	- Gelo Frost	20
53° cart.	- Disgelo Thaw	21
38° esp.	- Dilatazione Expansion	A32
54° cart.	- Valle glaciale The glacial valley	24
55° cart.	- Morene Moraines	22
56° cart.	- "Valli pensili" The hanging valley	23
57° cart.	- Ciclo dell'acqua The water cycle	25
58° cart.	- "Il gioco dell'acqua" The game of water	26
59° cart.	- Tipi di vegetazione Types of vegetation.	27.

NOTA: - I titoli fra parentesi, da usarsi all'inizio dello studio, vanno poi sostituiti con gli altri titoli espressi in linguaggio scientifico.

NOTE: - The titles in parentheses are used at the beginning of the study and then they are substituted by the other titles expressed in scientific language.

Bergamo, giugno 1970.

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1) Subject: force of attraction.
Materials: a basin, construction paper (pressed in layers) a jug full of water.
Command: pour the water slowly into the basin. Wait for it to be absolutely still. Tear the thin card in about twenty piecis, using your hands and not the scissors; the piecis of card should not be too large and almost square. Arrange them lightly on the surface of the water, away from the edge of the basin and in such a way that they do not touch each other.
What do you observe? If you want, you can write down your observation.
Statement: The piecis of thin card have been attracted till joining by cohesion force. This helps you to understand how particles were attracted to each other in space to form celestial bodies.

2) Subject: Centrifugal and Centripetal forces.
Materials: A bucket of plastic, if possible, water, a string.
Command: Take the small bucket, fill it about 3/4 full with water, attach the string to its handle and swing the bucket over your head.
What do you observe? Repeat the experiment slowing down the movement.
What do you observe? Repeat the experiment with the bucket empty, let it go.
What do you observe?

Statement: If we put something in circular motion, two forces result: one that attracts the thing towards the center, and the other that pulls it outwards. The former is called the CENTRIPETAL and the latter CENTRIFUGAL force. If an equi librium is maintained between the two forces, the body does not fall.

3a) Subject: Force of inertia.
Material: - cylindrical glass, with a flat base - 100 Lire coin -
- post card.
Command: 1. Turn the glass up side down; put the post card on top of it; and on top of the postcard put the money.
2. Take the postcard away with a sharp movement.

- What happened?
- Write your observations, if you wish.

3b) Subject: Force of inertia.
Material: - cylindrical glass, with a flat base
- water in a small pitcher
- sheet of strong paper.
Command: 1. Fill the glass a little more than half full of water.
2. Put the glass on the sheet of paper.
3. Finally give the paper a sharp pull.
- What do you observe?
- Write your observations, if you wish.

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3c) Subject: Force of inertia.
Material: - the lid of a box (rather large as that used for the "great division" box); - a glass marble - pencil.
Command: 1. Place the cover with the rim up, in the center of the table. Put the marble in the middle and against the short side nearest you. Place the pencil horizontally on the table at the same position as the short side of the box.
2. Now, with a rapid movement, draw the cover towards you, making it drag on the table, but stopping it suddenly.

- Observe and answer:
1. Compare the position of the marble with the rim of the box, from which it left. What has happened to the marble?
2. Compare the position of the marble with that of the pencil. What has happened to the marble?
3. Look up the word "inertia" in the dictionary.

Statement:
1. A body in the state of rest, that is immobile (the glass marble) maintains its state, that is, it remains still. The glass sphere remains still, in its position through the "force of inertia".
2. The force of inertia is the characteristic of bodies to remain in the state in which they are found, that is, not to begin moving when they are still or to continue to move, if they are already in motion.

3d) Subject: Force of inertia
Material: - solid rubber ball - a blanket.
Command: 1. Place the blanket on a smooth pavement. Then throw the ball on the blanket.
2. Repeat the throwing, doing it so that the ball falls on the pavement.
Note: The way you throw must always have the same force.
- What do you observe?
- Write your observations, if you wish.

Statement: Every body persists in its own state of rest or of uniform motion in a straight line, as long as there is no intervention by an external cause to modify this state.

4a) Subject: Force of gravity
Material: - piece of iron - sheet of paper - piece of cork - a feather - a plumb line - Newton's tube.
Command: 1. Hold in the same hand the first 4 materials listed. Get up on a chair and let the articles fall, all at once.
2. Take the Newton's tube keeping it vertically and then turn it over rapidly.

1) What do you observe?
2) Using the plumb-line, answer: In which direction did the objects fall?

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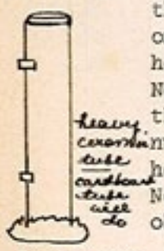
Statement: a) Gravity is the force that attracts all bodies towards the Earth. The force of gravity is equal for all bodies. The direction of gravity is that indicated by the plumb line.
b) Weight is the result of the action of gravity on the molecules that constitute a body.

It may be said that:
- The force of gravity increases gradually as the bodies draw near the center of the Earth and therefore diminish when the body goes away from it.
- Since weight and gravity are linked together, the weight of a body diminishes gradually as it goes away from the Earth and vice versa.

4b) Subject: The force of gravity.
Material: - Two equal sheets of paper.
Command: 1) Roll one of the sheets of paper into a hard ball.
2) Get up on a chair, then holding the flat sheet of paper and the ball of paper - drop both at the same time.
- What do you observe?
- If you wish, write your observations.

Statement: The weight of the two bodies (the sheets of paper) is equal. The sheet rolled into a ball fell more rapidly, because it has a smaller surface than the flat sheet; that is, a lesser quantity of air exerted pressure on it. The resistance met by the sheet of rolled up paper is less than that met by the flat sheet of paper.

5a) Subject: Hot air rises.
Materials: proper tube, clay, tin plate, cigarette and matches, tin can containing sand. (lid)
Command: take the tube, fix its base with a little bit of clay on the plate. Light the cigarette, take away the two stoppers on the side of the tube; hold the cigarette near the lower hole and note the direction of the smoke.
Now take the tin can, heat it very well and place it inside the tube closing the tube completely. After about five minutes take away the stoppers on the side of the tube and hold the lighted cigarette once again near the lower hole. Note the direction of the smoke this time. Write down your observations, if you want.



Statement: hot air rises, and the space left empty by it, is occupied by cold air.

(when air gets hot inside, vacuum is created, so the smoke is pulled in (attracted) and it rises)

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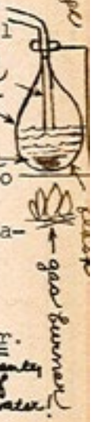
5b) Subject: Warm air goes up
Materials: a spiral, a knitting needle, a piece of plasticine, some litle candles, some matches.
Command: fix the spiral on the top of a knitting needle. Insert the knitting needle in the plasticine so that it stand up. Insert one or more candles beside it and light them up. (this is Swedish angels phenomenon)
What do you observe? If you want you can write your observations.

6) Subject: Volcanism (2nd experience)
Material: - in clay: volcanic cone with "pipe" - plastic funnel, threaded into a rubber tube - rubber stopper, pierced by a long glass tube - flask or decanter (= vase, of glass, with a large belly and a long straight neck) - spirit lamp or Bunsen burner, wire grid, matches - metal stand - properly set-up - sand of various grains and colors, powdered marble, earth, powdered wood-carbon (charcoal), water - houses, plants, shrubs, moss; stones powder and piece of pumice, landscape scenery: for the reconstruction of natural and geographical environment - wood support or platform with a central hole - large flat metal basin.



Command: 1. After having placed the metal basin on the table, put in the wood platform. On the platform, place the volcanic cone.
2. Thread the rubber tube through the cone, and arrange it so that the funnel adheres to the crater.
3. Place the planned objects for the reconstruction of the natural environment, completing the work with the landscape scenery.
4. On the floor, mount the metal stand, affix the flask and under it, the burner and the grid.
5. In the flask, pour sand, powdered wood-carbon, earth, water. Plug the flask with the rubber stopper.
Attention: Be sure that the glass tube draws deeply in the water.
Finally, light the burner.
Attention: Keep away and don't go near the cone, until the experience is finished.

Observe and answer:
1. The various substances listed above, contained in the flask, represent the "magma". Look in the dictionary for the definition of "magma".
2. Why have the materials been pushed out, together with the boiling water.
3. Draw the section of the volcanic apparatus, by using the proper classified nomenclature.
4. Mark, on a world map, the position of active volcanoes.
5. Draw a map of Italy, then locate the active volcanoes, designating them in red, and "extinct" volcanoes in black. Finally, look for articles about the old cities of Pompei and Ercolano.

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Statement: The volcano is vent in the earth's crust, from which materials of very high temperature erupt. One part of the material, by solidifying, accumulate around the opening itself, forming a volcanic neck.

7) Subject: Erosion
Materials: clay, water, watering can. (over clay, use loose stones, turn earth, sand)
Command: build a little mountain using hard clay for the very centre and softclay on top, then drop some water (rain) on top of the mountain with a watering can. (water washes off all but largest Receivi[illegible] material)
What do you observe? If you want, you can write down your remarks.

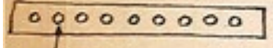
Statement: Where the earth is bare, the erosion is very great.

8a) Subject: Extention
Materials: a cylindrical or a rectangular jar of glass, a small bottle, a stopper, water.
Command: Take the small bottle and cork it, fill the jar with water; dip the bottle in water and take off the stopper.
What do you see? Write down your observations. (the space occupied by the air is occupied by water)

8b) Subject: Air occupies space.
Material: - funnel - water in a pitcher - rubber stopper with an opening - bottle.
Command: 1. Thread the funnel through the stopper and with it, plug the bottle. Then pour the water into the funnel.
Attention: the funnel must always remain full of water.
- What do you observe?
- Write your observations, if you wish.
2. Hold the stopper lifting it slightly, and pour the water again.
- What do you observe now?
- Write your new observations, if you wish.

Statement: Air occupies the space inside the bottle preventing the water from entering the bottle.

9a) Subject: Specific ~~weight~~ gravity (1st experience) We are looking for absolute weight
Material: - cubes, with an edge of 1cm; of the following substances: poplar wood, iron, lead, cork - hollow cube, in steel, with an edge of 1cm - liquid substances: distilled water, oil, pure alcohol, mercury - precise scale pan.
$\frac{P}{V} = \frac{45}{1} = 45$



10 cm cylinders made of all different substances... weighing each, we obtain the absolute specific weight
Command: 1. Weigh each of the 6 solid cubes, taking note of their weight. 2. Calculate the weight of the hollow cube.
Attention: Its weight represents the "tare".
3. Then, using the same hollow cube, weigh 1 cm^3 of each of the named liquid substances. Attention: We must obtain the "net" weight. (Absolute specific weight = weight − tare: this is also "net weight")
child weighs each substance.
- What do you observe?
- Write your observations, if you wish.
Statement: The ~~absolute specific weight~~ specific gravity is the ratio between the relative weight of a body and the weight of an equal quantity of distilled water. (P_a (water))

Absolute specific weight = $\frac{W}{V}$ = weight of the body in relationship to its volume; here because all cylinders have the same volume, 1, — we have a simple calculation and a good means for comparison.

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9b) Subject: ~~Specific weight~~ (2nd experience) Specific weight: as defined by water displacement to indicate volume
Material: - graduated cylinder (measuring tube) (100 cm^3) - water in a pitcher - various pieces of material: iron, marble, brass, wood, lead, mercury - precise scale pan.
Command: 1. Weigh each piece of material and note the weight, expressed in grams. 2. Pour the water filling exactly half the graduated tube. Then, one at the time, place each piece of material in the tube removing each before putting in the next. Each time, note the displacement in the water level. (to see result of volume)
3. Finally divide the weight of each piece by the volume of water displaced by each of them; you will obtain the specific weight of the different materials examined.
$\frac{P}{V}$ = weight / volume of displaced water
We define weight of object by increase of water in tube. This is "specific weight"
THEN $\frac{W}{V}$ = specific weight

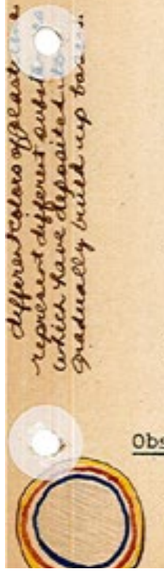
10) Subject: Stratification of rocks - a) Formation of a basin by sedimentation.

Material: - grey plasticine: about 2 Kg. - brick colored plasticine: about ½ Kg. - wax for modeling "Pongo": 1 cake (½ kg) of each of the following colors: yellow, black, white, green - circular disc of cardboard with a diameter of about 30 cm. - flat soup plate - oiled paper - knife - rolling pin, if possible short and thick - centimeter ruler and pencil - scissors.

Command: 1. The teacher has worked the grey plasticine, forming a ring, and placed it around the plate. Of the same grey plasticine she prepared a circular sheet, as big as the plate, with which she has covered the bottom of the same plate, obtaining a low and wide cylinder that has been completed by filling exactly the empty space. She has turned the cylinder upside down and placed it on the tray, which has already been covered with oiled paper. She has finally removed the plate, obtaining a concave vessel, called a "basin".

2. The successive phases of construction of the basin, illustrated below, represent the stratification, that is, the successive deposit of sediments in a basin. The teacher, with the yellow "Pongo" (which has been put to soften in a warm place) using a rolling pin, has prepared a circular sheet (diameter of about 24 cm) with a thickness of a little more than 1/2 cm. She has then placed the sheet on the basin. Pressing and removing excess in appropriate areas, she has, step by step, made this first strata adhere to all of the basin. The basin in this way has changed color: we can recognize only the grey rim.

3. The teacher has repeated the preceding process, working successively with "Pongo" black, white and green, ending finally with a circle of brick colored plasticine. The 4 sheet prepared have a diameter that decreases by about one centimeter; so that the brick colored sheet, the last of the series, has a diameter of about only 20 cm.



different colors of pongo represent different strata which have deposited gradually with up to...

Observe and answer:

1. Which color of material is placed first, and which was placed last? List the strata in the order in which they were placed by the teacher on the bottom of the basin.

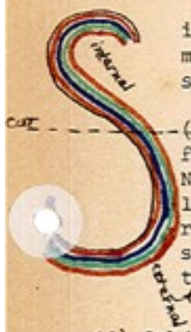
2. Among the concentric rings which constitute the sedimentary basin, which are the oldest: which are in the center and which are on the periphery? (periphery - first ones placed)

3. Using the same colors as in the experience, draw the section of the sedimentary basin and write your observations. (See illust. - after experiment 13 (10b))

4. What is the difference of position of the concentric rings between a sedimentary basin and a plateau?

5. Compare the drawing of Exercise no. 3 with that corresponding to the relative command illustrating the wearing away of sedimentary stratifications on a mountain. Write your observations basing them on the position of the strata of the same color.

6. With a black pencil draw on a sheet of paper a large S (capital manuscript letter). From the same point trace with a different color, another S, parallel to the first.
Now turn the paper, so that you see the S horizontally. On the left you will notice a sedimentary basin and a mountain on the right. Fold and cut the paper into 2 parts, exactly where the basin and the mountain are joined. Write your observations basing them on the colors. (layers on left (=external) rise to form the mountain.



11) Subject: Formation of the mountain.

Material: - 6 strips of material, rather firm (panno Lenci) of different colors; for example: grey, yellow, black, white, green, pink. The width of the strip of material must be about 30 cm and the length not less than 70 cm. (exactly same size (grey deepest - oldest; brown near top - recent)

Command: 1. On a table, lay on top of each other the strips of material. Attention: the laying out of the material must be done with care, because the strata which result must be visible.

2. Press your hands on the 2 ends of the strata of cloth, push from both sides towards the center.

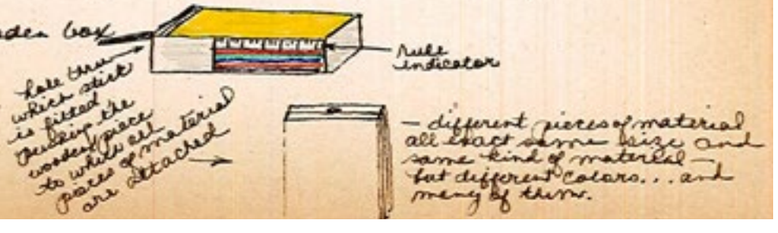
- What do you observe?
- If you wish you may write your observations.

3. Another time, with your left hand, hold the strips firm, and with your right hand, push the strips toward the center.

- What do you observe this time?
- Write, if you wish, your observations.

Statement: The formation of the mountain (called orogeny) has also been caused by: orogenesis.
a) lateral pressure (horizontally)
b) pressure from top to bottom and vice versa
supporting pressures of the continental mass, in determinated periods of the history of the Earth.

Also used: a wooden box



12) Subject: "Fracture" of the earth's crust

Material: - Rectangular parallelepiped having a square base: one of the bases is subdivided into 10 strips of equal width, but of different colors - a parallelepiped equal to the above, but composed of 3 prisms, obtained by dividing the base by means of segments joining the midpoint of a side with the vertices of the opposite side.

(the two are dark blue - sandy - the of wood - ten stripes; top red.

Command: 1. Place the whole parallelepiped on the table, in such a way that the 2 square bases are perpendicular to the surface of the table and the colored strips are horizontally in front of you. - This parallelepiped represents a series of 10 stratifications of sedimentary rocks, in their original position (horizontal), generally rigid.
Attention: the stratum marked by the red color is that which was most recently deposited.

2. Then, near-by, place the divided parallelepiped, in such a way that the disposition of the strata corresponds to the strata of the whole parallelepiped. - This new parallelepiped represents the example of 2 fractures caused by deforming pressures.

3. With both parts, but using different hand pressure, push laterally, from one side toward the top and from the other side toward the bottom, in such a way as to cause the displacement and the upsetting of the 2 masses of lateral rocks. - This fracture, accompanied by displacement of the rocks along a level is called a "fault". (fault level)

4. Finally, compare the position of the strata of the two "faults" with the strata of the whole parallelepiped.

- Write your observations.
- Draw the various phases of the experience.

Statement: As a result of the fracture of rigid rocks, the "fault level" can assume a horizontal, oblique or vertical direction.

(pressure on left (action) to right side, top to be right

13) Subject: Stratification of rocks: (before 10 b)
a) The wearing away of stratified sediments.

Material: - grey plasticine: about 2 Kg - brick colored plasticine: about 1 Kg - wax for modeling - "Pongo": 1 cake (½ Kg) of each of the following colors: yellow, black, white and green - circular disc of cardboard with a diameter of about 30 cm - oiled paper - knife, if possible with a serrated blade - rolling pin - if possible short and thick - centimeter ruler and pensil - scissors.

Command: 1. The teacher has worked the grey plasticine and constructed the model of a common mountain (an erect cone with a rounded vertex: diameter of 18 cm and altitude about 13 cm).
- She has cut from the oiled paper, a circle of the same diameter as the disc and has placed it on the disc and then on top of the paper, she has arranged the mountain that she has already constructed.

Different colored layers of plasticene - last brown layer which covers the mountains layers - and we no longer see them.
We see - what happens when top layers

NOTE: use the same colors as those for layers of basin).
GREY IS THE OLDEST: in center of mountain - periphery

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2. The successive phases of the construction of the mountain, which are described below, represent the stratifications, that is, the successive deposits of sediments. - The teacher, with the yellow "Pongo" (that has been put to soften in a warm place) using the rolling pin, has prepared a circular sheet (diameter about 35 cm) having a thickness of a little more than ½ cm. She has then placed the center of the sheet to correspond exactly with the top of the mountain. Pressing and removing excess in the appropriate areas; she has, step by step, made the sheet adhere to the sides of the mountain. The sides of the mountain have in this way changed color.

3. The teacher has repeated the preceding process working successively with "Pongo" of black, white and green, finishing the work with a strate of brick colored plasticine.

4. Finally, she has "decapitated" the mountain, giving the origin to a special plateau.

Observe and answer:

1. Which color of material is placed first and which is placed last? List the strata, in the order in which they have been placed by the teacher in constructing the mountain.
2. Are the oldest terranes (that is, that which the teacher, in the course of her work, placed first) on the periphery or in the center of the plateau?
3. Using the same colors as in the experience, draw the section of a mountain and write your observations.
4. After having worked with command no. 10 answer: What is the difference of position of the concentric strats between a plateau and a sedimentary basin?

14) Subject: Solar energy
Materials: a lamp with a stand, a tiny ball. (green bead)
Command: take a lamp, switch it on and place it in the middle of a table in such a way that the rays fall in all directions. A short distance away, place a tiny ball (since it represents the earth, the ball should be very small). Note now, what part of the total rays the ball receives. If you Want, you can write down your remarks.
Statement: the earth receives a very small part of the solar energy.

15) Subject: Illumination of the Earth
Materials: a light bulb, a tube, the blue and white globe. (black construction paper)
Command: take the light bulb on a stand. Put it into a tube and throw the light horizontally on the earth.
What do you observe? If you want, you can write down your remarks.
Statement: the sun can illuminate only half of the earth at a time, the other half remains in the darkness and this causes the day and the night.

16) Subject: The perpendicular and the oblique rays.
Materials: a light bulb, a tube, a board with a black surface.
Command: Take the light bulb and put it in the tube. Now throw the light on the black surface, first perpendicularly, and then obliquely.
What do you observe? If you want, you can write down your remarks.
Statement: the rays that fall perpendicularly, concentrate on a very small space and consenquently heat it much more than the oblique rays.

17) Subject: Illumination of the equator and the poles.
Materials: A light bulb, a tube, the blue and white globe, a string to measure.
Command: Take the usual bulb representing the sun, put it inside a tube and throw the light horizontally on the globe; then measure the distance of the lamp from the equator and the poles.
What do you observe? If you want, you can write down your remarks.
Statement: the distance of the sun from the equator is less than the distance between the sun and the poles. This is one of the reasons that it is hotter in the equatorial regions.

18a) Subject: Bad and good conductors of heat.
Materials: a knitting needle, a stove, a glass rod, a cylindrical stick of wood.
Command: take the three sticks holding one end of them in your hand. Approach the other ends to the flame.
What do you observe? If you want you can write your observations.
Statement: heat spreads inside the bodies but not at the same speed for all of them. The bodies in which heat spreads easily are called good conductors of heat, those in which it spreads slowly are called bad conductors of heat. Generally speaking metals are good conductors of heat, while glass, paper and wood are bad conductors.
(this needle will heat up very fast)

Ebony & glass are bad conductors; copper & aluminum good.

18b) Subject: Good and bad conductors of heat.
Materials: a stove, a box of Inggenhoutz, wax or parafine, water in a saucepan. (Jan - HOLLAND) (a box with several holes in which are wands of different metals)
Command: let the wax melt on the flame and dip in it the sticks of the severals materials attached to the box and they will be covered by a thin layer of wax. Boil the water, pour it into the box and put the box on the flame. (let dry) Then return rods to box.
What do you observe? You can write, if you want, your observations.
Statement: From the Inggenhoutz box we see also that not all metals are good conductors in the same way. Among the bodies wich are bad conductors, such as paper and wood, others moderately bad conductors, such as soil and stones.

copper aluminum etc.

19) Subject: Night and day
Materials: a light bulb, a tube, the blue and white globe.
Command: take the usual bulb representing the sun, put it inside the tube, throw the light horizontally on the globe, then rotate the globe to see how the light changes.
What do you observe? If you want, you can write down your remarks. You can write also the consequences of this movement.
Statement: since the movement is continuous during each moment of the day there is one part of the earth where the sun is rising: at that point it is dawn. In the mean time, on the opposite point the nights are beginning: it is sunset. To overcone this inconvenience, man has created the "time-zones".

"Suppose you are a little Chinese boy."

Another exercise: is a black folder, we open to find this white revolving disc on which we place the 4 labels shown.

20) Subject: Obliquity of the polar axis.
Materials: An orange or an apple, a knitting needle, a lamp supported by an obyect.
Command: Take the needle and stick it into the orange, passing through the center of the fruit. Put then the orange in front of the lamp representing the sun and make turn on itself and round the sun. (show first ↑ ; then inclined in relation to plane-table; slightly north)
What do you see? Does it correspond to the earth's position?
If you want you can write your observations.

21) Subject: Marking off the imaginary parallels.
Materials: a stick on a stand with three strings attached to it: one red and two blue; a pencil; the third globe.
Command: take the stick, place it in such a way that the central string is at the height of the equator and the other two are at the level of the tropics.

1. With the topmost blue string and a pencil pointing on the summer solstice, trace a line on the globe; this corresponds to the Tropic of Cancer: it is the last point on which the solar rays fall perpendiculary.
2. With the red string trace the equator.
3. With the lower blue string trace the Tropic of Capricorn.
4. Bring back the globe to the summer solstice, find the point of tangency with the Earth. Trace the latitudes Which mark the artic and antartic circles.

22) Subject: The seasons
Materials: a lamp with a stand the blue and white globe (cardboard plane with ellipse on which path globe can travel)
Command: place the bulb representing the sun on a stand in such a way that its light strikes the equator; revolve the globe around itself and around the lamp with its axis pointing always towards the north.
What do you observe? If you want, you can write down your remarks.
Statement: the inclination of the axis of the Earth is the cause of the seasons.

23a) Subject: air - pressure
Materials: two test-tubes (one should fit inside the other); water.
Command: take the two test-tubes, fill the bigger one half full with water, immerse the smaller test-tube in it until it is just below the water level. Tilt the test-tubes and hold them in a slanting position.
What do you observe? If you want, you can write down your remarks.
Statement: the water in the (bigger) test tube tends to come out, and the pressure of the atmosphere pushes the smaller test tube upwards.

23b) Subject: Air - pressure
Materials: a glass, water, a piece of paper.
Command: fill a glass with water (upto the very brim) and cover it with a piece of paper. Turn the glass over quickly.
What do you observe? If you want, you can write down your remarks.
Statement: the pressure of the air is stronger than that of the water inside the glass and it prevents the water from coming out. (even if one lets go. Holding the glass of water upside down)

23c) Subject: Air: pressure
Materials: A vacuum pump, a hard-boiled egg, a beuta.
Command: Attach the vacuum pump to a water-tap. Insert the extremity of the pipe in the opening of the pump and the other extremity in the opening of the (beuta). Put a hard-boiled egg on the beuta opening. Now open the water-tap.
What do you observe? Write down you observations, if you want.
Statement: inside the beaker a vacuum was created and the pressure of the air outside forced the egg to enter the beaker.

(running water sucks air out of beaker, vacuum is created & the egg goes inside)

24) Subject: the rapidity of cooling depends on the nature of the body.
Materials: two equal burners, two pans of the same size, water, sand, two thermometers.
Command: place some sand into one the pans, and into the other pans an equal quantity of water. Put the pans on two burners and heat. Use two thermometers to measure the temperatures.
Which one heats up first? When the water and the sand have reached the same temperature, remove from the fire.
Which of the two will cool first? Why?
Statement: the water is slower in heating up but it retains the heat longer; the earth (on the other hand) heats up more quickly but also looses the heat quickly.

25) Subject: Origin of marine currents. (an impression)
Material: - large transparent dish (capacity about 5 liters) - - water - spirit lamps, pan, matches - ice cubes - eye-dropper - spoon - red ink and green ink.
Command: 1. Bring to a boil about 3 liters of water and pour it into the large dish. Leave it for 3 minutes.
2. Add very slowly, along the edge of the dish, about 2 liters of ice-water, in such a way as there is formed in the bottom of the dish a cold layer of water.
3. Then using the eye-dropper, put a little red ink into the water.
Observe: How does the color move, when reaches the are where the two strata of water mix. (will hover between two layers)
- Write, if you wish, your observations.
4. Now, using the spoon, put some cubes of ice into the water. Pour into the cubes some drops of green ink.
- What do you observe?
- Write, if you wish, you observations.
Statement: The surface of the sea has currents; some of which are hot, others cold according to whcter they come from the equator or the poles. The marine currents have their origin thus from masses of water of different temperature.

26) Subject: The stratification of rocks
b) The wearing away of stratified sediments.
Material: - kitchen strainer - little sacks containing respectively: fine earth, lamp-black, powdered brick or fired-clay, powdered chalk, sand - 1 small tube (also: the external part of a plastic ball-pen) - 1 box lid sufficiently large - large spoon.
Command: 1. Pour into the strainer 1 spoon-ful of fine earth and shake it uniformly, distributing the earth over the whole surface of the box lid.
2. Repeat the work with all the "powders", following the order given in the list of material. - You have laid in flat layers the "terrane" of various types, that is, of different colors.

* Could substitute earth of different colors... maybe

3. First, without using the tube and then by using it, blow very, very gently obliquely on the strata. (Like you were a sandstorm)
Observe and answer:
1. List the five strata, in the order in which they have been deposited. Which, among them, is the oldest, that is that which had been placed first? Which of the strata is the most recent?
2. The "wind" that produced the blowing ware away the stratified sediments. Which strata appeared first? Which strata appeared last? (remain longest)

Statement: The oldest terranes appear on the surface last, because of the wearing away of the most recent terrane.

28) Subject: Destruction of the rocks.
Materials: a piece of calcite, a plate, hydrochloric acid.
Command: put the piece of calcite in the plate; then pour a little bit of hydrochloric acid over it.
What do you observe? If you want, you can write down your remarks.
Statement: the hydrochloric acid dissolved in the water, destroys the rocks.

32) Subject: Expansion
Materials: a small bottle with the stopper water.
Command: take the bottle, fill it completely with water, close it tightly. If it is winter, and it is very cold, put the bottle outside the window leaving overnight.
Otherwise put the bottle in the freezer compartment of the refrigerator and take it out after twelve hours.
What do you observe? If you want, you can write down your remarks.

Statement: water is the only body that when solidifying instead of decreasing increases in volume. This causes many difficulties.

ECONOMIC GEOGRAPHY

Chapter I. Where do people live? A work parallel with the geography nomenclature.

Chapter II. How do people live? A study that follows the chapter of functional geography with the impressionistic charts.

WHERE DO PEOPLE LIVE?

Material: The materials are a series of maps of one's own country. The children can make these maps, using the frames from the geography cabinet. We list here that series developed for the study of the economic geography as related to Italy. We note that additional charts or substituted charts may prove more appropriate to the study of another country.

1. Map of the country (general character): green land and blue water. Two white areas represent territory within the country that does not belong to Italy.
2. The capital city.
3. The land borders.
4. Seas and coastlines.
5. Gulfs. (An accompanying blank map with labels of the gulfs.)
6. Ports and harbors. (+ blank map and labels)
7. Islands.
8. Channels and straits. (+ blank map)
9. General orographic systems. Mountain ranges divided into specific systems. (+ blank)
10. Volcanoes. (+ blank map and labels)
11. Plains.
12. Rivers.
13. Affluents and tributaries.
14. Rivers in relation to the mountains.
15. Lakes. (+ blank map)
16. Depressions: areas below sea level.
17. Passes and tunnels. Means by which Italy is put in relationship to other countries.
18. Roman roads.
19. Railways.
20. History: the coats of arms of each region. (+ blank map and labels and c-o-a)
21. The elements combined: all those factors which have been analyzed separately are shown.

NOTE: The general organization should follow this pattern. For instance, we consider the mountains, the plains, the rivers and then the lakes in that sequence. When we come to the final chart where all the elements are united, we have a new level. We have created the atlas one step at a time with the possibility of understanding the total picture in terms of all the previous work.
The use of transparent sheets are a possibility for developing some of the maps.

HOW DO PEOPLE LIVE?

The concept of economy must be presented first. With the children we consider the first chart of the Fundamental Needs of Man to draw the children's attention to certain aspects shown: that is, how ONE need is satisfied depends to a certain degree on the climatic conditions of the place, and it reflects the standard of life of the inhabitants.

Because a people cannot produce everything that it needs to satisfy the needs of its inhabitants, the country tends to become specialized in the production of that merchandise which the country uses as a means of trade to obtain precious goods it cannot obtain at a reasonable price. Here there is no distinction between wheat and gold. If we mine gold, but we cannot produce wheat, then wheat becomes more precious than gold.

Regarding the problem of specialization, Montessori used to quote the example of the countries of modern Europe, those not able to produce citric fruits and therefore had to import those fruits from warmer places. The technically advanced countries produce a kind of machinery; and then use that as an exchang e for other goods. Here we have introduced the concept of imports and exports. There is a kind of interchange between

different countries that is very similar to what happens in the living being. We recall the Great River which demonstrates this exchange of products. And here, too, is the concept of specialization: cells of the different organs differ because they have different roles to perform. Each organ, says Dott.sa Montessori, represents a different country. And no organ nor country can produce all the products necessary for its total survival. Each organ takes from the river what it cannot produce and puts into the river those products which it produces in excess.

Why do countries become specialized? Why doesn't it produce everything that it needs? Montessori suggests that we answer these questions with a comparison of evolution. The cells begin the same. Then they specialize, each cell having the possibility to specialize in a particular way. Next the communications system is built: that is, the circulation system is developed. And finally, in the more highly evolved state, the nervous system is developed.

Primitive man did not change until he organized his work and became specialized. The question is: What can we do for developing countries? We must help them to organize the production of specialized merchandise to bring them to this point on the evolutionary track rather than supplying them with manufactured products. The latter solution is political behavior. Often the powerful political unit buys raw materials cheaply from an underdeveloped country and then sells the product manufactured from those raw materials back to the country at a greater cost. This is, in the big picture, anti-progress for mankind.

The Alphabet of Economy

Dott.sa Montessori notes: When we write, we need an alphabet. With a small number of letters---21, 24, 35---we can write all the words we need. To represent quantities we have the alphabet of numbers: only nine numbers serves us for the writing of great quantities in the decimal system. There is an alphabet to write music. An alphabet for chemistry. We must have an alphabet for economy.

Thus she developed a box of symbols which give us an alphabet for the economy of the world in which we live. (See INSERT: description and character of symbols.)

The Materials consist of:

1. Two wooden boxes with divisions (those used with the red and blue printed alphabets) in which the symbols are kept. On the bottom of each division, one symbol is glued to control placement.
2. At least twenty copies of each symbol prepared on small labels the size of the letters, each fitted to the corresponding section. Those sections which show, for instance, the different races of men are larger cards. (See INSERT on symbols.)
3. A Guide Table: a chart giving the symbols and their meanings. NOTE: The symbols are introduced on the pattern of the sandpaper letters.
4. A map of our own country showing ONLY the economic symbols. NOTE: In a series of presentations following the introduction of the symbols, we analyze these symbols shown on the map.
5. Various tables: for example, a Table of Metals. On this table we see the various elements and their corresponding symbols, so that we can take the metal symbol of the economic alphabet and designate a particular metal.
6. Information from the Chamber of Commerce. Here is an excellent source of information about the economic life of the country. The important information is the various products that the people can produce and where. In this way, we consider the variations in production from one geographic region to another; or from one political division to another. The information we obtain will be divided in the latter way; but our consideration can then proceed to the geographical factors involved.
7. Rubber stamps of the symbols needed to analyze the economic production of the country. Example: A stamp showing a bunch of grapes. With a blank map of the country we want to show the comparison of grapes produced by the various regions of Italy. Our first work is to establish a mathematical scale for the symbol. That is, how many litres of wine produced will each bunch of grapes represent? If we designate one bunch of grapes as the symbol for the production of 1,000,000 hectometers (hectometer = 100,000 litres), then we can show the corresponding number of stamps on each region according to its production. If

we have a region that produces less than 1,000,000 hectometers, such as Liguria, we must then show only a fraction of the bunch of grapes, the stamp, or "4 grapes." In this way, then, we can analyze the economic production of each area in relation to the others taking one product at a time. And we can culminate the work with a total representation of all the products shown together on a map. But this analysis one product at a time provides an excellent analysis of the geographical factors that influence production.

The Cosmic Considerations of Economic Geography

We can draw a parallel between the study of animal physiology and economic geography. We can compare the circulation of the blood to foreign trade. In blood circulation, we recognize certain blood vessels. In economic geography, we identify commercial trade routes. The arteries of the circulation system travel outwards towards the periphery and the veins travel back to the source. We note the red blood in the first and the blue in the second. . .and the different directions. These two directions can be compared to exports and imports (arterial and veinal circulation) in commercial trade. And in our work with arrows, we pick up the two corresponding colors. The red oxygenated blood becomes our red arrows and symbols; the blue blood of the veinous circulation becomes our import arrows and symbols of blue.

Material

1. A second series of symbols in two boxes: now one is red and the other blue.
2. A series of maps: the first is a world map with our own country in red. . .the heart; the second map again shows our country as the heart, and now we see red arrows going from that center to other points on the world map, the arrows of exports; a third map showing the red country, the red arrows and symbols again indicating the exports and in addition, blue arrows and symbols showing the imports. . .from the various countries where our imports come from.
3. Further maps.

After the consideration of the exports and imports related to our own country as indicated above, we turn to a consideration of the exports and imports of another country. And it is in this examination that we observe those same arrows and symbols in opposite colors and positions. We get a strange feeling from this transformation of colors. We discover that "your exports will be my imports."

Now, instead of using a new map, we represent on the same map the imports of our own country and another country. Here we will begin to have a great confusion of arrows and symbols. This great mess is our point of arrival.

Here we have the idea that there is a great circulation of goods and ideas. There is an intercommunication, an interdependence among men. All these lines that cross and compound so that we can no longer distinguish one from the other have a powerful graphical result. We have a netted material of lines, woven so that we can no longer distinguish the beginnings of the threads. And through this graphical result we reach a psychological concept: Human solidarity in time and space.

Montessori concluded the presentation of these ideas (1949) with the geography chart #15: Rivers of the World and the Blue and White Globe:

> "I would like to conclude this idea, offering you this last image. This world on which we live is surrounded and perfectly crossed by rivers, oceans and seas that are nothing more than the images of human solidarity. We must have the capacity to think of the world as a unique body. We must look at it with different eyes. We must feel it psychologically in our hands. We must feel the pulsing of its veins. With an awareness that is spiritually alive. It is alive and all of us belong to it. We all belong to this unique nation."

At the conference for Education & Peace, Ultrecht 1937, Dott.sa Montessori refused to sign a political manifesto for the unity of Europe. She replied that she sought that nation which united all men, not just the union of Europe. She had a world wide vision of collaboration for peace. When asked which was her own country, she replied:

> "My country is a star that revolves around the sun and is called earth."

GEOGRAFIA ECONOMICA - ECONOMIC GEOGRAPHY

"Vino in hl prodotto in Italia nel '63"
"Hectoliter of wine (22 gal.) produced in Italy in 1963"
(dal: "Bollettino Mensile di Statistica")

= = = = = = = = = = = = =

Regioni / Regions	- Vino prodotto / - Wine produced	Regioni / Regions	- Vino prodotto / - Wine produced
Piemonte & V.d' Aosta	5.194.600=	Lazio	3.617.100=
Liguria	381.000=	Campania	3.163.400=
Lombardia	1.746.800=	Abruzzi	1.659.100=
Trentino-Alto Adige	1.158.500=	Molise	590.800=
Veneto	7.040.800=	Puglia	8.097.600=
Friuli-Venezia Giulia	958.000=	Basilicata	818.100=
Emilia-Romagna	4.240.500=	Calabria	1.043.900=
Marche	2.710.600=	Sicilia	3.908.700=
Toscana	4.306.900=	Sardegna	1.671.700=
Umbria	733.900=	I T A L I A	53.042.000=

(dal: "Calendario Atlante De Agostini, 1965, pag.65)

"MOVIMENTO NEI PRINCIPALI PORTI"
"FLOW OF TRAFFIC IN THE PRINCIPAL PORTS" (nel '62)

(a: navi arrivate e partite;
docked and sailed ships;

b: 1.000 t di merci imbarcate e sbarcate;
1,000 tons of loaded and unloaded goods;

c: 1.000 passeggeri imbarcati e sbarcati;
1,000 embarked and landed passengers;).

	a	b	c
- SAVONA	4.509	5.689	-
- GENOVA	18.838	26.743	450
- LA SPEZIA	3.624	6.015	-
- LIVORNO	8.809	5.839	29
- PIOMBINO	9.802	3.726	727
- PORTOFERRAIO	5.276	334	581
- CIVITAVECCHIA	4.253	2.479	731
- NAPOLI	30.516	10.799	2.130
- CAGLIARI	4.343	1.360	322
- OLBIA	2.059	139	398
- MESSINA	1.558	180	20
- PALERMO	3.766	661	219
- TRAPANI	4.090	99	85
- SIRACUSA	442	72	-
- AUGUSTA	3.368	10.600	-
- CATANIA	1.432	508	-
- TARANTO	635	457	-
- BRINDISI	2.425	946	223
- BARI	2.270	3.594	5
- RAVENNA	4.319	6.749	-
- VENEZIA	12.808	12.337	203
- TRIESTE	10.422	5.163	282.=

(dal: "Calendario Atlante De Agostini, 1965, pag. 102)

gr/

NOTE - NOTES

1) Indice - Simbolo 1-40: prodotti agricoli e industriali; caccia e pesca; industrie; investimenti.
Simbolo 41-43: popolazione.
Simbolo 44-50: religioni.
Simbolo 51-55: razze e stirpi.
Index - Symbols 1 to 40: agricultural and industrial products; hunting and fishing; industries; investments.
Symbols 41 to 43: population.
Symbols 44 to 50: religions.
Symbols 51 to 55: races.

2) I simboli sono in doppia serie: rossi per le esportazioni e azzurri per le importazioni.
The symbols are in 2 series: red for exports and blue for imports.
a) Per lo studio di un Paese, il bambino può indifferentemente usare simboli di uno dei due colori, perchè - a questo livello - non lavora al commercio con l'Estero.
In the study of one country the child may use either color because at that level he is not concerned with imports and exports.
b) Le 3 sagome d'uomo sono in 2 colori, allo scopo di poter mostrare tanto l'immigrazione quanto l'emigrazione sia nell'ambito del proprio Paese (immigrazione ed emigrazione "interna") sia in riferimento ai Paesi esteri.
The 3 sizes of men are in 2 colors in order to be able to show immigration and emmigration both within the country and with other countries.
c) I simboli delle religioni sono in 2 colori, allo scopo di mostrare l'espansione delle stesse (es. le "missioni").
The religions symbols are in 2 colors in order to show the movement of religion (i.e. missions).
d) I simboli delle razze sono in 2 colori, allo scopo di mostrare il movimento delle stesse, in relazione all' immigrazione e all'emigrazione.
The symbols for races are in 2 colors in order to show the movement of races in connection with immigration and emmigration.

3) Ciascuna serie è organizzata in un proprio ""alfabetario"" colorato.
Each series has its own colored box.

4) Ci dovrebbero essere almeno 25 esemplari per ciascun simbolo, in ciascuna serie.
There should be at least 25 of each symbol in each series.

5) Oltre a quelli elencati, può essere necessario preparare altri nuovi simboli, per incrementare lo scopo di questo lavoro.
It may be necessary to prepare other new symbols to increase the scope of this work.=

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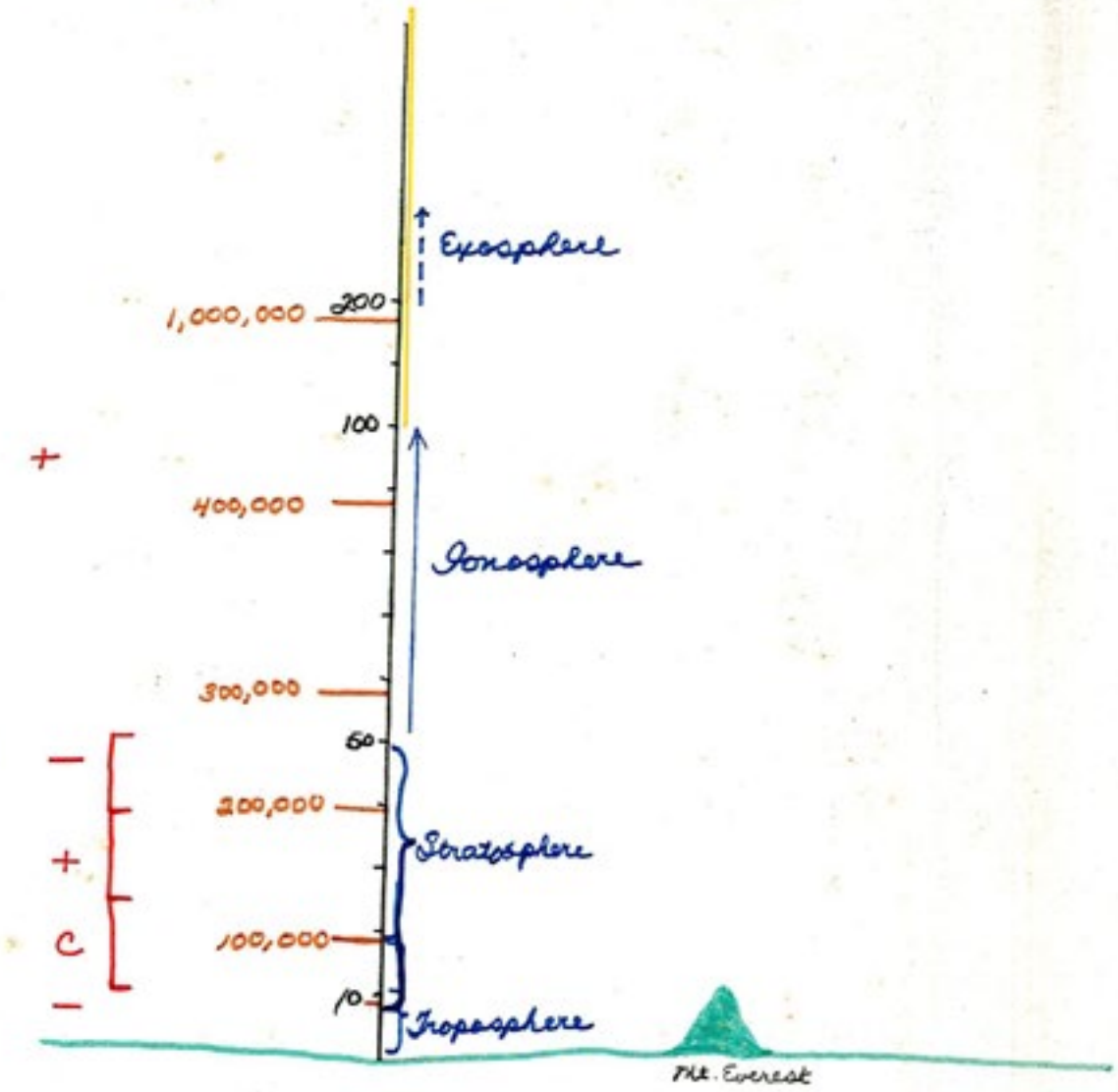

feet
miles
temperature