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Box 11, Folder 46 - "Materials Obviate Fatigue" ("The Montessori Method"?) (E.M.S.)

Edwin Mortimer Standing

In this connection I recall a remark which Dr. Montessori happened to make - parenthetically - at a lecture in which she was demonstrating certain numerical operations with her wonderful material for showing the decimal system. It happened she had to make the number 1,462. So she picked out a 1 thousand-bead-cube, 4 hundred 'squares', 6 ten-bead-bars and 2 units, and placed them on the demonstration table. There were then actually 1,462 beads on the table; and she had put them all out in less than thirty seconds. "now", she remarked, (before going on with the operation she was demonstrating) "supposing all those beads had been loose together in a bag, and I had been obliged to count them all out, and organize them according to the decimal system, before I could even begin my sum: what a waste of time and energy! But the order was there waiting for me in the material itself. All which might be regarded as a symbol or epitome of my method as a whole." The child's mind, ever seeking order is helped by finding this order waiting for it in the material. In general the materials are so made as to liberate the child's mental energies for the comprehension of ever higher forms of order. In short - in constructing our "prepared environment" for the child - we could not do better than take as our maxim St. Augustine's famous maxim: "serva ordinem et ordo servabit te".(1)

MATERIALS OBVIATE FATIGUE

We repeat: because the child's store of mental energy is so limited we must be careful not to expect it to do a work beyond its strength, especially as we are expecting it to work spontaneously.

(1) Serve order and order will serve you.

Nor must we expect the child to make a long - continued effort purely on the mental plane. For the child, as we must ever bear in mind, is not a 'pure spirit': his is very much 'an intelligence closely linked up with a sensory-motor system'. The teaching apparatus has immense value because it forms material channels along which, or rather alongside of which, can flow this precious stream of mental energy. Without this material support and clarification the child's mind would get quickly fatigued, and lose interest. This precious streamlet of mental energy would soon be exhausted, or deviated, were it not for this material "point of contact". But when linked to this it bears the child forward - calmly, steadily and continuously - for a long time. In this way there is brought into being what is a past chapter we described as il piccolo lavoro ("the little work") - clear, definite and limited - which is so characteristic of "the second stage", - the stage which is so fruitful for the building up of a vital, dynamic system of knowledge.

In some operations - as for example the apparatus by which the child works out his multiplication tables for himself (see p) it would almost seem as if Montessori has un-neccesarily complicated the materials used. What a lot of little actions are involved in this work, - the finding of the little red number card, its insertion in the little "window", the regular counting out of the same number of beads, the moving along of the little red disc on the line of numbers above, the adding up to find the new multiple, and the recording of the result on the form supplied. Then the whole cycle of these activities to be repeated for each new multiple discovered. Indeed some of these movements, like the moving along

of the little red disc, could hardly be regarded as actually essential.

Yet Montessori has put in all these little actions - regularly repeated - on purpose. Why? Because all these little details, taken together, form a succession of rhythm of movements which hold the child's attention and keeps up his interest. As Montessori says:

> "Our main purpose is that the child shall repeat this exercise many times spontaneously; and for this there must be interest. All these little facts, which seem unimportant to us, form a group of movements which hold the child's attention through a work which in itself is uninteresting. It is a simple work, mentally, combined with a series of movements. And as a consequence it becomes so restful to the mind that the child can go on doing it for a long time with little effort. We are, as it were, binding his mind around this very simple work, and the highest thing he can find to do is to memorize it.
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> "We have found repeatedly that this calm and monotonous exercise seems to lead spontaneously to memorization. But if we told the child to sit down and memorize the tables from a paper without these movements he would find it a great burden."

To conclude then, in auto-education everything depends upon our being able to direct, down to the smallest and apparently insignificant details, this precious stream of mental energy into creative channels, economizing it so that not a particle of it shall be wasted.

THE SEPARATION OF DIFFICULTIES

It is, if we may use the term, "de fide" (of faith) in the Montessori method that the child's mind works spontaneously, and we can, and should, base our system of education on that spontaneity. Nevertheless it is not an easy matter to direct a group of 30 - 40 children in such a way that they all continue to work individually in the same room together, harmoniously, spontaneously, and for long periods at a time. This is but another way of saying that Montessori teaching is at once a science to be studied and an art to be practiced. Many an enthusiast has set off gaily to apply the Montessori method, but has failed for lack of a clear all-round grasp of the principles behind it. And, contrariwise, of many of those who have studied the method not a few have come to grief because they have never acquired the living art of putting those principles into practice. Practice indeed makes perfect; but before and behind that practice there must be real knowledge. Many are the pitfalls which beset the beginner in the Montessori way. They are in fact even more numerous and more dangerous than those which beset the beginner in the traditional manner of teaching. This is because, as the proverb says, "the best, corrupted, becomes the worst".(1)

In ordinary traditional methods of education success largely depends on the teacher; but in a system based on auto-education success depends as much or even more on the spontaneous creative mental activity of the children. This in turn implies, on the one hand, the removal of all obstacles which might impede that spontaneous functioning; and, on the other, on the bestowal of such means as

(1) "Corruptio optimi pessima"

as would assist it.

All this is only another way of saying that first the teacher must learn how to reduce her intervention to the minimum possible so that the activity of the children shall reach the maximum; and secondly, to emphasize the importance of the "Prepared Environment."

This does not mean, of course, that the teacher becomes a negligible quantity - far from it. It means that her success will largely depend on her ability in knowing how to establish the right relationship between all these freely moving and choosing children and this prepared Environment which is the sine qua non of their liberty.

Obstacles to Spontaneous Mental Activity

The obstacle which may hinder the free functioning of the "knowing faculty" are varied and numerous. We might indeed say that the greater part of this book has been devoted to the principles we must bear in mind if we wish to remove all such obstacles, and we have not yet come to the end of our discussion on them.

Starting from our first principle therefore - "that the natural inclination of the mind is towards truth" - we may take it as a general rule that if a child does not work spontaneously, it is not because he is stupid, vicious, or lazy, but because there is some obstacle, or group of obstacles, that stand in the way. It is of the utmost importance that these obstacles be removed, not only for the sake of the work but even more for the sake of the child's own development. For it is by and through this spontaneous work he not only learns, but also creates himself - the man-that-is-to-be.(1)

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(1) Vol. I, Chapt.

Deviations and Their Cure Through Work

Not a few of the obstacles, which hinder the child from this spontaneous work, may be within himself. They are those "deviations" of which we have spoken in chapter X, Vol.I which take the form of disorders or disharmonies of personality of one kind or another.

> "The normal child can apply himself to his work and continue it with all his psychic energies. Wheras deviated children have a tendency to flit from one thing to another. They show an inability to fix their attention for any length of tile, or to obey, or follow another person. This latter phenomenon might be defined as a break between the inner life of the child on the one hand and his actions on the other. He no longer possesses his own actions. The relations between these two streams of energy, mental and physical, are 'snapped'. The"normal" child can direct his intelligent action according to his own ego: therefore his attention is fixed and his actions are orderly. When the personality is integrated every action, however simple, tends towards an end, and we see at once that such a child is normal. But when the relation is snapped the mind may take the strangest turns: the child's movements have no object and he brings about nothing but disorder and distraction."

That is why the first essential for any child who comes to a Montessori school is to undergo that process of"conversion" or "finding himself" which we have called normalization through work.

Mental Barriers

But even assuming a child has become "normalized", has established the right 'rapport' between himself and his environment, even then the directress may find that in some particular subject or subjects the child does not seem to show an interest or aptitude nor any wish to work.

What are we to make of this? Does it mean that our first principle and article of faith has broken down - that we can no longer trust ourselves to the spontaneous activity of the child's mind? No! It only shows there is still some obstacle, within or without, which has not yet been removed. In such cases it often happens that a continued lack of interest, amounting to an aversion to a certain subject, is due to a deep-seated and very resistant diviation which Montessori calls a 'mental barrier'. This takes the form of an unconscious antagonism to a particular subject. This is nearly always caused by some painful associations connected with a governess at home. More will be said about these mental barriers later on.(1)

It is quite possible, however, that a child may <u>not</u> be suffering from any such mental barrier, and yet nevertheless show no interest in any particular occupation presented by the Directress. In this case the cause may be that the occupation is either too easy, or too difficult. As quoted above "children cannot be interested in an exercise which does not call forth a work of intelligence". What we need, then, is to find a 'golden mean', an exercise which seems just beyond the reach of the child's mind, yet is in fact so near to it that it can be reached by a <u>slight</u> stretching ("the

(1) Also see <u>The Secret of Childhood</u> - Montessori

little work"). There must be a mental effort or interest will flag, vut it must not be too great. "I am going to teach you a new kind of sum this morning, Janet", I once heard a Directress say to a child about 8 years of age. "Are they hard sums, Mother?" enquired the child. "Yes, rather hard," replied the nun. "Hurrah!" exclaimed the little girl clapping her hands.

SEPARATION OF DIFFICULTIES

It often happens that a child finds a piece of work too hard because his mental energies are being directed to too many difficulties at once. Hence with Montessori a principle of great importance is "the separation of difficulties" and the tackling of each of them independently. In nothing has Montessori's practical genius revealed itself more clearly than in the brilliant manner in which she has - first, analysed out the component difficulties in the various subjects, and then (as we showed in the last chapter) succeeded in overcoming each by means of an occupation which is fascinating in itself. No one can get any idea of her astonishing originality and ingenuity in this respect until he has had the opportunity of studying, in detail, the various materials - all perfectly graded - along which the child passes in each of the "prepared paths". (1) Such a study, however, is not for a book like this, confined to principles, but rather for the demonstration-room in a practical course for teachers. What is so remarkable about Montessori's genius is that she not only sees the general principle but displays at the same time such an admirable ability to apply it in the smallest practical detail.

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(1) See diagram p.

Example From Multiplication

To illustrate this principle of the "separation of difficulties" let us take an example from the teaching of Arithmetic, in particular from the teaching of Multiplication.

"In Multiplication," says Montessori, "there are two main difficulties. First, the memorization of the tables; and secondly, a whole series of difficulties of reasoning - all of which center round one main difficulty."

We have already described, earlier on, how the child works out the various multiplication tables for himself by means of the Multiplication Board and Pegs (p.). We should like to mention here that to help in the memorization of the tables which he has worked out there are various other activities. These include the Multiplication Pattern Game in which each separate table is discovered to have its own pattern; and also various multiplication flash-card games which the children can play singly or in groups. And of course they become familiar through practice with the famous Table of Pythagoras.

Assuming then that the first difficulty has been disposed of - that of the memorization of the tables - we can now turn to the difficulties of reasoning. For convenience sake we can state the first and fundamental difficulty to be grasped in an algebraical form, thus:

$$(a + b) c = ac + bc$$

That is to say the child must be quite clear how he can multiply the sum of two numbers.

Here are two coloured bead-bars, the nine-bead-bar and the

four-bead-bar, and they have to be multiplied by three. We will put out the two bead bars together, like this:

Now we have to find out what the nine plus four would come to taken three times:

To do this, then, we arrange them thus:

You might say, "But that is so clear and obvious, why dwell on it?" And I reply, "Because just here, we have the center, the whole crux of all multiplication."

Now we will take a more complicated example but you will see it is essentially the same process. You will see what I mean in a minute. Now, look! I put out other groups of beads - this time including tens, hundreds and thousands. With the golden bead Decimal System beads I make the number 1,232.

I do it with: - <u>one 1000-bead cube</u> two <u>100-bead squares</u> three <u>10-bead bars</u> two <u>unit beads</u>

This number, 1,232, we are going to bultiply by 3; that is, we are going to take it three times.

So, taking <u>each separate bead-group</u> three times we get: -

Always we are doing the same thing - a quantity taken so many times. And so we get our first rule; "We must analyze the multiplicand - the number to be multiplied - and then take each of the parts so many times."

Still following the principle of the analysis of difficulties, we are now in a position to go further and meet the next difficulty. I now take a new number 1,412, which has to be taken three times. And so we get the following arrangement: -

3 thousands 12 hundreds 3 tens 6 units

But now we have come across a new diddiculty. When I multiply the four hundreds by three I get 12 hundreds. But according to the law of the Decimal System, which by now we know so well, this cannot be, since we can never have more than 9 in any category, i.e. on any plane in the hierarchy of numbers.("At 9 there is always a crisis", see p.)

So I rearrange the hundreds-so- putting ten together on one side and leaving two hundreds.

ten 100 bead squares piled - and on top of each other - to be exchanged for one 1000-bead-cube.

two 100 bead squares

These ten hundreds I now take to the "bank" and change them

for 1 thousand-bead-cube which I place along with the other three thousand cubes - leaving the remaining two hundreds still in the hundreds' position.

So now we have the final result:

4 thousand cubes 2 hundred squares 3 ten bars and 6 units - 4,236.

Let us pause a moment to see how far we have progressed in separating the second group of difficulties - that is, the difficulties of reason as opposed to difficulties of memory. We have learned: -

First, to analyse the number to be multiplied.

Second, to multiply each of the parts separately - and now

Thirdly, <u>to group the results so obtained according to the law of the decimal system</u>, i.e. every time we get above nine, in any category, something has to be passed up to the next category just above.

The facts of memory, our first difficulty, remain the same on all these levels and create no more difficulty amongst the millions than the units. "<u>The really important thing is to remember with which group we are dealing</u>. (i.e., with units, tens, hundreds or thousands, etc.)

These two factors, then, by their interplay form the warp and woof of all multiplication: -

(a) the algebraical taking of quantities so many times - and -

(b) the organization of the multiples so formed according to the decimal system.

This "organization" according to the decimal system" gives rise to the "promotion" of numbers, what is usually termed 'carrying' - but it does not alter the fundamental basis of what multiplication really is. For always I do it in this way: -

A. One group of numbers taken so many times. Another group of numbers taken so many times. A third group of numbers taken so many times and so on. It does not matter where you begin - with the thousands or with the units, or any place in between, it always comes to the same thing at bottom.

B. The numbers, thus taken so many times, we organize according to the rules of the Decimal System. Ecco tutle! (That's all!)

To complete the picture we ought really to go on and show how the same analysis of difficulties is made use of when we come to teach the child compound multiplication. We then come to realize that we have to analyse the multiplier as well as the multiplicand.

Unfortunately it is not possible here to give any idea of the wealth, variety and originality of the many materials which Montessori has devised for making clear to the children the essential nature of these four great numerical operations - addition, subtraction, multiplication and division - not merely in small numbers but reaching into millions. Each of these materials is made to shed light on a particular difficulty or group of difficulties.

But it is not only a question of getting the child to understand just once. It is more a matter of getting the children, not only to see a truth in a momentary flash, but of - shall we say - living with it as a constant companion. It would be better still if we said as a "travelling" companion. For - by using the specially prepared materials - and using them repeatedly (in the "second stage")

the child travels along in company with it, in those "comfortable shoes of the mind" of which we spoke in an earlier chapter. In this way these mathematical relationships become a part of the child's nature - second nature if you like, something which he cannot forget.

Thus to take an example. When at a later stage the child happens to be doing a sum like 3,879 x 6, and doing it on paper, without the assistance of any concrete materials, he never multiplies purely mechanically without realizing what he is doing; never forgets what the numbers really represent. Thus, for instance, when multiplying the number 3,879 by six, when he comes to multiplying the number 7 by 6, though he may say to himself (for brevity) six sevens are 42, at the back of his mind as he does so there is always the consciousness that it is not really six sevens but six seventys. Thus he knows well that the answer is not really 42 but four hundred and twenty. And if he says to himself (again for brevity) "put down 2 and carry 4" he knows that he is putting down 2 tens and carrying 4 hundreds. Always at the back of his mind, or only just inside his subconscious, is the knowledge of what each figure signifies in its place in the "hierachy of numbers".

Thus, by tackling each difficulty separately as it comes, and through a particular materials designed for just that difficulty, it is surprising what a mental agility the children acquire with regard to every aspect of that wonderful gift which we derived from the Arabs - the Decimal System. This is because they have learned to work with their heads (reason) as well as their fingers, - not "just with a rule of thumb".

In figure p. , we see a child of 8 or 9 working with the "chequer board", one of Montessori's most ingenious materials

for teaching the anatomy of Compound multiplication. Here in this material the following difficulties have been isolated:

1. The analysis of the multiplicand.
2. The analysis of the multiplier.
3. The carrying of numbers up to the next category.
4. The visible shifting to the left so many places according to the multiples of ten in the multiplier - all these have been isolated and kept apart by the material itself. Even more than this; some of the difficulties have been, as it were, held in suspension by the material itself until such time as the child's mind - busy at first with something else - is free to deal with them, when it comes to getting the final answer. To describe in detail how this multiplication chequer board actually works is far beyond our present scope. It forms an interesting study even for adults. In fact, in every Montessori Course, many students - we might say the majority - have come to understand mathematical operstions (through these various materials) in a manner which they never realized before, because at school they had been taught to do their sums quite mechanically, without understanding the reasons for the various steps involved.

MENTAL BARRIERS IN ARITHMETIC

The frequency of 'mental barriers' - especially in arithmetic - and the difficulty of removing them, emphasizes the stress we have laid in other parts of this book on the importance of getting children to start from the very beginning in the Montessori way.

In all my experience I have never met, or even heard of a child who, from the very beginning, studied Arithmetic along Montessori lines developed an aversion for this subject. This is because at every step along the Prepared Path the difficulties are so carefully analysed and separated and presented through appropriate materials which are interesting in themselves that the child masters them thouroughly as they come. And all the time, as a consequence, the child experiences a growing sense of achievement and power - what Montessori used to call "Valorization of personality". And all this in addition to the pure intellectual joy which comes with "the miraculous act, which we call knowledge". (Marcel Gabriel. See M. M. Chapt.)

On the other hand, it is only too easy for just the opposite to happen in an ordinary class where children are taught collectively, and where the work centers round an Arithmetic text book. There it often happens that a child - perhaps, through an absence caused by sickness, or because he is naturally slow in the up-take - falls behind the rest of the class. Then, just because the teaching is collective and the method of study is "linear" following the textbook the poor child feels himself falling further and further behind. An increasing feeling of frustration depresses him and a deepening sense of inferiority overwhelms him. As a consequence

his associations with this subject become so unpleasant that, as time goes on, there is built up in his subconscious a mental barrier against it, in the effort to preserve himself in his own estimation.

Pulling Down the Mental Barriers

A montessori classroom is the best place for a child to get rid of any such mental barrier, and for various reasons. The whole atmosphere is against it. In the first place the children are all working individually, and there is no competition (except what the children sometimes voluntarily arrange amongst themselves). And so the child's self-esteem is not wounded by invidious comparisons.

Then, again, whatever the subject may be which forms the child's aversion, he will be sure to see other children working at it eagerly, spontaneously, joyfully and by choice. He is often surprised at this, and will stand and watch this - to him - astonishing phenomenon with interest. In these circumstances the Directress may often overhear some such conversation such as this: -

Newcomer: "I hate doing sums."

Well established child: "So did I when I first came to this school. But you will soon get to like sums; here they are different."

As the child watches his comrades at work at the particular subject which is his bête noire, he is also interested to note how it has been transmuted, by means of the materials, into a different and more attractive-looking occupation altogether.

I once had a boy of eight brought to me to be tutored who hated the very thought of Arithmetic because he was floundering hopelessly in a morass of confused and half understood ideas. I

put him on to working out numerical operations in the concrete by means of the wonderful golden bead decimal system. He enjoyed the work from the start and made steady progress. But the strange thing about it was that this approach was so utterly different from what he had been doing before that he actually did not realize it was the same subject. He thought there were two entirely different kinds of arithmetic as different from each other as geometry and algebra!

When a child with a strong mental barrier against "doing sums" is placed in the prepared environment of the Montessori class what usually happens is something like this: He is probably put to work - at the suggestion of the Directress at some subject which he likes. Then one day when he has finished his work, in a moment of relaxation he wanders round the class watching what the other children are doing, and he observes one of his companions working away at arithmetic, at his hated subject. This, at once, intrigues him. His interest is aroused and he stands watching. Maybe he asks the other child some questions, and the latter may even offer to explain to him what he is doing. At any rate, his interest has been aroused.

This is the moment the ever-watchful Directress has been waiting for; the birth of a genuine interest. She will know even better than the "little teacher" how to fan this small flame of interest into a larger one. She is now able to obtain the "consent of the child",which is so important, by asking the newcomer if he would like her to show him how to work with the golden beads. If she is an experienced Directress it will not take her long to find out exactly where things have gone wrong with this child, and she will

know which is the best exercise by which he can start and build up a solid foundation. Both in the diagnosis and the remedy she will make use of her knowledge of the wonderfully graded series of arithmetical materials.

Let us suppose, for example, that Tom has come to the Montessori School because he has trouble with such a "barrier" against Arithmetic and has fundamentally confused ideas with regard to the very structure of numbers; so much so that he is apt to confuse, shall we say, the number 36 with 63. To clear up the trouble it will be necessary to separate the difficulties, and by so doing get down to the basic elements. The beauty of the Montessori Arithmetic materials lies in the fact that these simpler elements are always visibly and palpably ready at hand.

Various possibilities are open to the Directress. Thus she could get the number cards - the tens and unit cards - and by superimposing the unit cards on the ten cards could make the two numbers 63 and 36. Then by removing the unit cards and placing them below she could decompose the two numbers; and in so doing, the difference in their "internal anatomy" would become evident.

By superimposing the unit cards on the tens once more she remakes the numbers. But it might happen that even this does not make the matter clear to Tommy. So the Directress goes a step further back, analysing still more fundamental difdiculties. She now gets the golden bead materials - a box with tens and a box of units - and puts out the corresponding tens and units next to the card - thus:

If, after doing this, the Directress on testing Tom's comprehension by asking him to make some new numbers, finds that there still linger some difficulties in his mind will go back still further back. She will get the whole Decimal System outfit, with the units, tens, hundreds and thousands and corresponding cards and start Tommy on the job of putting out the famous Birds-eye View of the Decimal System,(described earlier on pp.). And when that is done she will give him various numbers to compose with the number cards and the corresponding beads.

What she has been doing, in fact, by these demonstrations is to analyse the symbolic representations of numbers, as written on paper, gradually replacing them with concrete realities, until finally she presents to the child truths which shine directly on his intelligence with a luminous self-evidence.

Of course, it would have been much better for Tom - and for any child - to have begun the study of numbers and numerical operations in the concrete, only gradually passing by clear and easy stages to the purely symbolic. In this way he would pass "from the known to the unknown" "according to the tendency of nature", instead of being dragged from one imperfectly known operation to another still more imperfectly known; and so on indefinitely until it came to the moment when in despair he gave up the struggle, sinking in the quagmire of mental obscurity. There are many adults who went through this experience at school, who as a consequence, become assailed with a sense of inferiority in any circumstance

which they are expected to do even simple numerical calculations. On the other hand the writer (who was one of these unfortunate persons) has been astonished again and again in teaching Arithmetic the Montessori way to find how quickly the children develope an agility in mental calculation which he has never attained and never will. The fact is, that many calculations which still present difficulties to such adults - on account of a faulty foundation laid during a sensitive period - are simple and easy to these children in spite of their tender years. All which bears out Montessori's oft repeated statement that "most of the difficulties in Arithmetic are of our own making".