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THE PROBLEM OF TRANSITION FROM PRIMARY TO SECONDARY MATHEMATICS

BY

HAROLD FLETCHER

I WANT to talk about a particular aspect of our work that is probably the most difficult situation we have to meet, at least in our country. It is this transitional period between the primary school and the secondary school—a problem which in my country I do not think has really ever been solved.

In England, we have this 11-plus examination, which determines very largely what is done in mathematics. It is rather interesting to know that so important do some people feel this examination to be that they worry about it from the time a child enters school, and not infrequently I meet infant teachers who, when I suggest some of Mr. Sealey's efforts to them, say, "But we have the 11-plus". With the 5-year-old children, they are thinking more about what type of thing may be set in the 11-plus than anything else and it is to that end that many of them seem to work.

You may recall also a previous talk of mine where I said that this examination, which in my view has had a rather bad influence on mathematics in Britain, is the Procrustean bed of primary mathematics, which means that there are many children who do far too much and there are other children who do not do enough, and it is possible that a clever child can be held back a considerable time because what he could well have got on to is not in the examination syllabus. So at the change-over we have a great many difficulties, and we have children going on to the secondary school in England who are really fed up with mathematics.

We also have another trouble here. On the whole I should think 20 to 25 per cent of the primary children go into grammar schools and in my opinion this is far too high a percentage, because as I go round grammar schools I meet the mathematics teachers in particular, who are very depressed. They have their group of very clever children, the kind of children who, as I have said many times need a guide and that is all; they can get on; and they have these other groups who are just fed up with it; they are not up to the standards that the grammar school people want; so we get skilled professional, good mathematicians who are just being frustrated. So we have in our grammar schools exactly the same problem as we meet in our secondary modern schools and when we find secondary modern schools trying to cater in their syllabuses for the G.C.E. in order to ape the grammar schools, which happens a lot in our country, then something, I think, is going wrong.

Is there an answer to this? How are we trying to combat it in England? What I am going to say may not apply in your country, but it is a problem that is worrying *us* and it is worrying me considerably and I should imagine it is going to worry the primary school people more.

One of the things that I think may be done is that someone may possibly write some text-books that would meet the situation of this transitional stage. I think that if we can get some books written that are almost do-it-yourself books, then you can give these to the brighter children and they can go on by themselves. We are always met with this situation where we have certain groups who can get on and do not need any help. These people can read the books, they can understand the mathematics; they have great vision, they can just get on. Then we can give more attention to the others.

Perhaps it may be that programming is the answer to this situation, this transition—again the question will be: "Can we find the people who can write the programmes?" because the teaching machine without the programmes is useless, but it may be that this could be a solution to our difficulties.

One thing is certain—when they come from the primary school into the secondary school, we have got to find a new line of attack. Remember I am speaking of England here, because, on the whole, in the secondary modern schools, the children are totally fed up with mathematics. It has been injected. This, I think, in the next

eight or ten years will change, because people such as Mr. Flavell and Mr. Sealey and others are spreading the gospel so much that we shall get children, I hope, coming into the secondary school with a different attitude from the one they have had to date. When they used to come to me, I often used to say, "To-morrow morning you can do any subject you like. Which one are you going to choose?" Games is the first, then we have music; some will say arts and crafts, we may have a few say English but when it comes to mathematics, there are only about two or three who will ask for that and this is rather a pitiful situation. So whatever else we have got to do, we have got to change the tone.

It used to be that, on going to the secondary modern school, the children had their first introduction to algebra or their first introduction to geometry, so they said, "We have got something new!" That is now breaking down and it will have to be altered, but one thing the schools will have to do is present the subject in a new way and I might make some suggestions on what I did in this respect. I think it got results as far as I was concerned, in that it gave an attitude, because it is a new attitude that we have got to foster in England after the 11-plus. I have no hesitation in saying that we ought to start, not by worrying about timetables, not by worrying about the syllabus at all, but we must try and create a new atmosphere within our schools.

I used to take the entire entry myself in the hall for a certain period of time, talking to them, getting them to talk to me; some of them would be listening, some of them would not, but you can usually tell who is not listening and these I brought into the conversation very rapidly. I used to have in the hall with them the five or six masters who would be talking to them when they split up into their various groups.

We probably used to talk about money first—anything to get them talking. Or we would put a lot of number patterns on the board and see if they could spot them. Whatever else we did, we kept off sums—long multiplications, long additions, horrible subtractions. You may see in a few minutes how we tactfully tried to bring these into being later. I used to ask them such things as, "What does a pound mean to you?" They used to say, "Eight half-crowns", but I would reply, "No, that isn't really what a pound means, that is equivalent change that we can get for a pound". On one occasion, I remember I was not getting on very well until a lad put his hand up and said: "It'd be two days' fags for my mother". I thanked God that he was in the class, because before I knew where I was, I was getting so many things given me that could be bought for a pound that I was well made. And they started to take an interest and subtly, without them knowing, they were saying eight of some thing at half-a-crown and four of some thing at five shillings. They were doing an enormous lot of this which we call "mental".

My next step was £100 and the moment that I said "£100" I got some phenomenal things said to me: "Motor car!" I said, "Good, what make?" They used to join in. "Austin!" "Good, what year?" They said, "New!" I said, "All right, how shall we find out?" Some lad said, "Let's go and ring up the garage, sir." "Any other ways we can find out?" Eventually, they said, "The newspaper, the adverts at the back," which was what I wanted to get on to with them. Eventually we found a 1940 Austin advertised for about £98, so then we went into a discussion on "was this sensible spending?" I was not worried about whether they could add or subtract or multiply as yet, I did not want this and in this transitional period this particular line I am taking is rather important to me.

From £100 I went to £1,000. I got some shocking things there. "House!", so we asked questions about houses. These children have no idea of what you can get for a sum of money such as this.

The next point I used to concentrate on was measurement and for this I called in every master in the school to provide me with articles that dealt with measurement and we used to have tables all round the hall with everything that involved measurement that we could find. You might say, "You didn't half waste some time!" I did not mind at the beginning. I would let them loose looking at these things and then we would have a discussion on measurement. This measurement is rather interesting. I do not know how I would define it. I would probably say that it is assigning materials to certain properties and if you were to turn round to me and say, "What properties do you mean?" I think I should reply, "Properties that are changed by combination."

I think in all the books that we have, there should be certain sentences that should be discussed and if anybody is writing a text-book for the transitional period, if a certain section deals with things for discussion, they will be doing a service to teachers, because teachers say, "I know we ought to discuss, but I can't think of anything that we can discuss."

The children used to write these things out. We always used to start: "A pint is a measurement." I can imagine why that was the first in my area because undoubtedly, it was the one that

was known most by the fathers. These are some of the things they used to write: "A coat can be measured in money." "The placing of the legs on a table is an angle measurement." "Calories give an energy measurement." I liked this one: "The length of a stride of a guardsman is a time measurement prior to the Coronation March." That child had heard that before the Coronation, the Guards went out and timed it so that they arrived exactly at 11 o'clock and not at a minute past. "A chisel is a measure for joint making." Then they put a horrible one in: "Speech, manners and appearance measure manliness." I had one that I had to destroy in my school: "Kindliness and understanding measure a teacher."

I would be prepared if need be to spend an entire term with children, discussing things in general, doing quick little exercises on paper, if I thought I could wipe out their aversion to doing sums. We lead on subtly to other kinds of things that are considered essential. I used to tell the children: "Tables of units of measurement are found in most diaries. Cut them out and paste them in a book." I want these children to start their own books of what they have discovered and their own books of what they are doing. I wish that this was done in primary schools. There is not as close a relationship between the secondary schools and the primary schools as there should be.

There is one thing I always give them to do—to find out from all the older children they know in the area what could be bought for a pound in their childhood days compared with what can be bought for a pound today, and then from the the two, we can get quite a lot of mental arithmetic or little short problems or little sums that will please them.

It is at this stage that I give them sums of this type:

(*a*)		(*b*)	*st.*	*lb.*
	29		2	9
+	38	+	3	8
	67		6	3

(*c*)	*lb.*	*oz.*	(*d*)	*s.*	*d.*
	2	9		2	9
+	3	8	+	3	8
	6	1		6	5

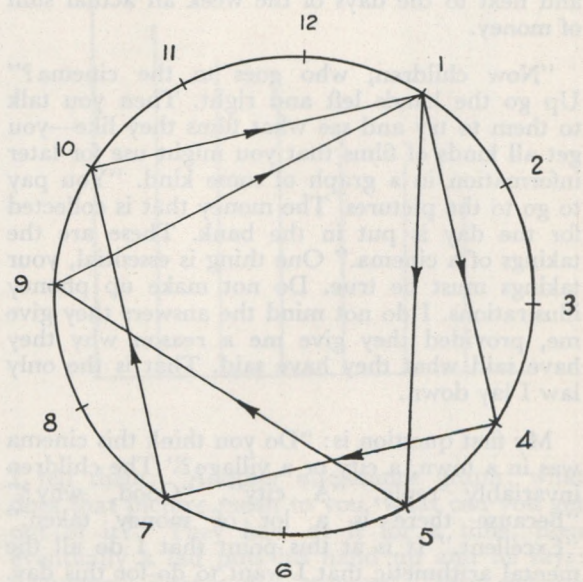
(*e*)	*ft.*	*ins.*
	2	9
+	3	8
	6	5

They laugh when you put those up because they can do them easily. We give them a series of sums like this to do and you will have noted here that we are using the same particular numerals, 3 and 8 and 2 and 9. In these first examples, the same figures are always used, but the answers are different. And so we lead to an argument about the mathematics of adding measures together. They usually tell me, "You can't have 17 lb. in (*b*)," or "You can't have 17 pence in (*d*)." You could, but you don't. We are leading in this way to a study of the system of measures.

I maintain that this is the best way of revising at the beginning of their career, at this transitional stage. If they do not know their measures and their weights, then I allow them to have their tables in front of them in order to see the solution, because if I am going to wait until they know them without the tables, I am going to wait a long time.

We not only do these with addition, we do them with subtraction, multiplication and division. First of all, I should have a series in which I had given the measures, followed by another series in which they had to put in the measures.

It may be that another suggestion that will interest the children is to get them to make a circle or a kind of template, divide it into 12 like the clock and later into 36.



You can do a lot of these together, just make one and then with a good compass point, get rolls of paper and go through each one, pricking them all out to save the time of joining and then get

them to join up lines. We could start at 1 o'clock and ask the children first of all to join up one number and the next number following, so that if we call the first "n" then map on to "$n + 1$", so they will go from 1 to 2, 2 to 3 and put in an arrow to show the direction in which they are going.

Many questions can be asked about these examples, such as: How many vertices has each figure? What patterns appear to go clockwise? What patterns appear to go anti-clockwise? Each pattern has a basic step which you use again and again as you go round the circle; each step measures or subtends an angle at the centre of each. The pupils can measure the angle clockwise for each pattern.

I would like to suggest where I think we should bring together with these children discussion and practice of mental arithmetic and perhaps graphical work. I usually start with this:

S	...	...	...	—
M	...	...	...	£ 5
T	...	...	...	£ 3
W	...	...	...	£16
Th	...	...	...	£ 4
F	...	...	...	£20
S	...	...	...	£25

You have some fun when you put that on the board because usually they cannot make out a word of it. Eventually they see it is the days of the week and next to the days of the week an actual sum of money.

"Now children, who goes to the cinema?" Up go the hands left and right. Then you talk to them to try and see what films they like—you get all kinds of films that you might use for later information in a graph of some kind. "You pay to go to the pictures. The money that is collected for the day is put in the bank. These are the takings of a cinema." One thing is essential, your takings must be true. Do not make up phoney illustrations. I do not mind the answers they give me, provided they give me a reason why they have said what they have said. That is the only law I lay down.

My first question is: "Do you think this cinema was in a town, a city or a village?" The children invariably reply, "A city". "Good, why?" "Because there is a lot of money taken." "Excellent." It is at this point that I do all the mental arithmetic that I want to do for this day. I say, "All right! Now we will imagine that they are all children. How much do children pay to go to the pictures?" "A shilling." "Fair enough. How many children went on Wednesday?" In time we get 320. Then we imagine they were all adults. Eventually they come to the conclusion that it cannot be in a city because of the numbers attending; it must be a small town.

What I am suggesting to you is that you go to these cinemas, get some of these details and use them with children at this transitional stage. Once they see that you have taken real things, they will take a real interest.

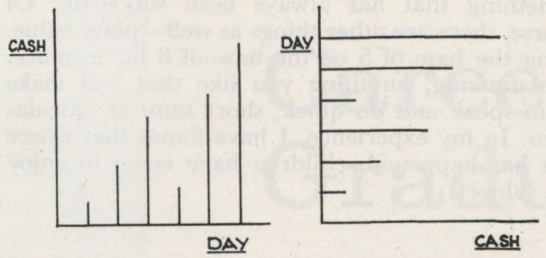
I then banish all thoughts about mathematics and I say to the children: "Let's talk about a town." We talk about town councils and what town councils do and some children say, "Well sir, they stop you riding on the recreation ground on your bicycles". So generally in our discussion we introduce them in the mathematics lesson to bye-laws. "There was a bye-law in this town and the answer's on the board." They have a look at it. No Sunday cinemas.

Then comes my great question. "When do you think it is half-closing day?" In reply they always give me the day that it happens to be in their own town. Often they say, "Tuesday". "Good. Why?" "Because it is the least money." Then we go into a general argument again and it is generally agreed that on half-closing day, all the shop-keepers go and so, instead of being the least, it ought to be the most, so the immediate reply then is "Saturday". Then somebody is not long in saying, "No, nobody would close shops on Saturday, that's when they would take more money than they would any other time." Then somebody will spot it—"Wednesday".

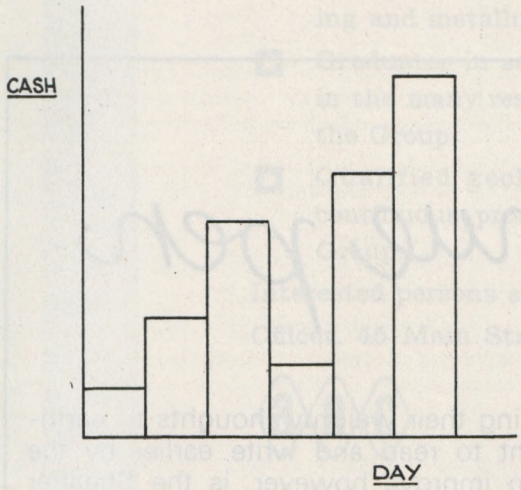
Then I ask: "Why £20 on a Friday?" They all shout out the answer to that—"Pay day!" I come to Saturday. "Why £25 on a Saturday?" Here I get some astonishing remarks. "The children don't go to school." "There is a children's matinee." "They have two performances at night." "Well, if it's in a town, sir, the people who come out of the country do their shopping by the bus, have their fish and chips, go to the pictures before they go back." The best I have ever had was: "A Saturday night is the night when the young men take the young girls to the pictures and take them in the dear seats to show off."

With these new children, if they are in any way disturbed about their mathematics, you might like to produce something that is quite elementary statistics. From those elementary statistics, produce a white paper: in other words, this can be put into English sentences. From there we go on to drawing, putting those statistics down in picture form, remembering what the Chinese say: "A picture is worth a thousand words". I get them to draw a graph of the takings. We shall

probably have the days on the horizontal axis. Then we will have the days on the vertical axis and the cash on the horizontal.

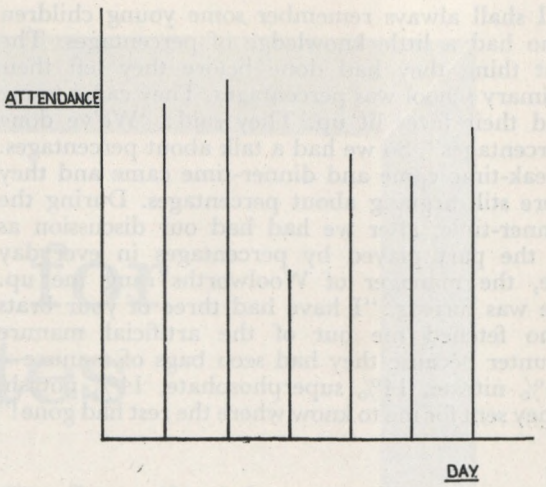


Finally, we will have the days and the cash again, but this time put into a histogram where we have got area frequencies instead of lengths.



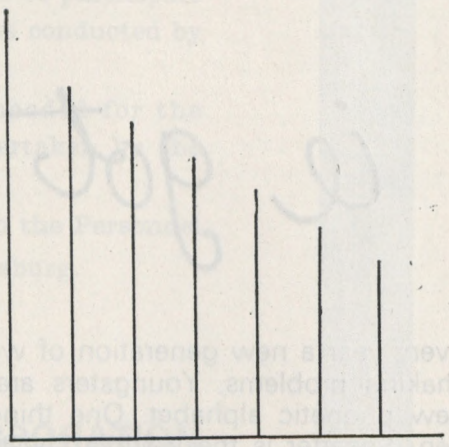
So in one lesson, we have taken some actual figures, we have produced a white paper on them, we have done our mental arithmetic and we have produced our graphs.

I usually end this by saying: "Now I am going to draw some pictures without any numbers on at all. You can make any comments on it you like". I might draw something like this:—



I tell them, "This is the attendance for a class," and I usually ask them rather a stupid question, such as: "On which day did the circus come to the village?"

Then we end up with perhaps one like this:—



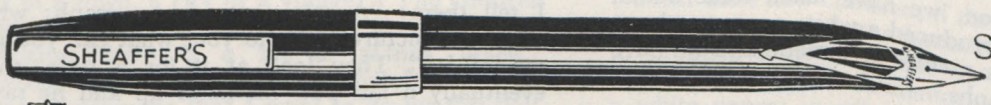
I tell them: "Another attendance graph: what does that picture mean to you, what can you get out of it?" They look at it for a time, then eventually a lad puts his hand up and he says: "Mumps". That is all—"mumps". "Why did you say mumps?" He replies: "Well, they started to get them and when we know anybody's got anything, if we can get a chance to get it, we will have another day off and it soon spreads".

I shall always remember some young children who had a little knowledge of percentages. The last thing they had done before they left their primary school was percentages. They came to me and their faces lit up. They said: "We've done percentages". So we had a talk about percentages. Break-time came and dinner-time came and they were still arguing about percentages. During the dinner-time, after we had had our discussion as to the part played by percentages in everyday life, the manager of Woolworths rang me up. He was furious. "I have had three of your brats who fetched me out of the artificial manure counter because they had seen bags of manure—14% nitrate, 14% superphosphate, 14% potash. They sent for me to know where the rest had gone!"

Unless a new approach is found and something new is done, we are going to have children who will detest mathematics as long as they are in school. You have to give a new presentation to these people—a programme or a do-it-yourself text-book will help some children. Bringing in different examples where they fill in the units is something that has always been successful. Of course, there are other things as well—place value, using the base of 5 or the base of 8 for instance, free drawing, anything you like that will make them speak and do quick, short sums or calculations. In my experience, I have found that where this has happened, children have come to enjoy the subject.

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