



The Future of the Mathematical Association

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8. In Geometry, Trigonometry, Theory of Equations, and Dynamics the use of Infinitesimals and the methods of the Calculus should be freely permitted.

9. The subjects of the examination should be in accordance with the Schedule appended, due regard being paid to the second recommendation of the Sub-Committee.

SCHEDULE.

PURE GEOMETRY.

Geometry of Straight Lines, Circles and Conics ; Inversion, Cross-ratios, Involution, Homographic Ranges, Projection, Reciprocation and Principle of Duality ; Elementary Solid Geometry, including Plans and Elevations.

ANALYTICAL GEOMETRY.

Straight Lines and Curves of the Second Degree ; Homogeneous Coordinates ; Tangential Coordinates.

Excluding the application of homogeneous coordinates to difficult metrical questions ; Invariants ; and Analytical Solid Geometry.

ALGEBRA, including Elementary Theory of Equations.

GEOMETRICAL TRIGONOMETRY. *Excluding* Spherical Trigonometry.

ANALYTICAL TRIGONOMETRY.

Properties of circular, hyperbolic, exponential and logarithmic functions, with real and complex argument.

Excluding the *proofs* of the Infinite Products for Sine and Cosine, and of the Series of Partial Fractions for the other Trigonometrical Ratios.

CALCULUS.

Total and Partial Differentiation ; Taylor's and Maclaurin's Theorems ; Elementary Integral Calculus ; Simple Applications to Plane Curves (especially to such as are of intrinsic importance), to Maxima and Minima, to Areas and Volumes, and to Dynamics ; Curve tracing, not as a rule to scale.

Excluding Differential Equations.

DYNAMICS.

Elementary Statics, including Simple Graphical Statics ; Elementary Kinematics and Kinetics, including motion of a rigid body about a fixed axis, and motion of cylinders and spheres in cases where the centre of gravity describes a straight line.

Excluding Hydrostatics and Hydrodynamics.

THE FUTURE OF THE MATHEMATICAL ASSOCIATION.

SINCE my article on "The Neglected Teacher" appeared in the *Gazette*, I have received a number of letters favourable to the proposals there sketched out.

Prof. Alfred Lodge, M.A., Charterhouse, Godalming, writes :

I have read your article in the *Mathematical Gazette* with immense pleasure. It opens up vistas of usefulness, *e.g.* it is to be an intelligence bureau for answering questions. Now two or three questions I want to ask are :

(1) What is best book for studying convergency of series (with sufficient illustrative series) for school purposes ?

(2) What is best book for trilinear and areal coordinates ?

(3) What is best book for tangential coordinates ?

At Coopers Hill we did nothing of this sort, so one is naturally rusty. My colleague, Tuckey, is good on them all, but I would like to be happier on them for my own sake. Can you give me your ideas ?

Also (4) where can one get hold of first notions on theory of groups, and (5) on theory of functions? To No. (4) I expect you will say Hilton. If so, I will certainly get it.

We have some very good mathematical boys here, and after they have secured their scholarships there are still two terms in which they are with us before going to college. A good mathematical library of not too difficult books is just what we want.

Again, as regards the *Intelligence Bureau*, if half a dozen sub-editors each engaged to examine new books with a view to culling *new ideas, suitable for school purposes*, in connection with definite mathematical regions,—e.g.

Pure Algebra, such as series, continued fractions, etc.

Higher Trigonometry.

Calculus, including reference to such pretty problems as your one in *Nature*.

Statics and Dynamics. (There is a new book by Jackson & Milne on Statics—for beginners—which is a vast improvement on the usual run.)

Analytical Geometry.

Pure Geometry.

—and if they published the results of their observations in the *Gazette* it would much assist men who are preparing scholarship candidates.

Perhaps some similar work might be done for elementary mathematics for general school work—in fact, Jackson & Milne's book belongs rather to this category. But in this connection the best assistance, to my mind, would be given by sets of simple illustrations of use of mathematics *drawn from real life*, so that by degrees the text-book examples would become more living and concrete. At present, what is called *Practical Mathematics*, is too fragmentary, too much divorced from the regular routine of upward progress to be much use for schools.

We suffer in schools from lack of time and lack of money to attend meetings of learned societies. It is a pity, because quite good men come to us red hot from their university training, and cannot keep it up by the natural method of rubbing against their peers or their leaders personally. A résumé of progress in some branch or another of mathematical investigation, written by a leader *in sympathy* with those who are thus out of personal touch, but are still keen students, would be a vast help and inspiration. If we succeed in increasing our membership as suggested by you, the *Gazette* could be enlarged, and much of what I have outlined might be done.

It would encourage us to form little mathematical associations of our own, each at his own school, or at groups of neighbouring schools, for mutual discussions and reading of papers, by giving us the needful ideas to work upon.

Mr. C. H. Blomfeld, M.A., the Grammar School, Bradford, writes :

I hope the suggestions you make with regard to the conduct of the *Gazette* will be carried out. I have been a member of the Association for several years, and with the exception of the reports and discussions of the reports of the committee for the reform of the teaching of Elementary Mathematics, I have rarely found anything of general interest. The whole *Gazette*, it appears to me, is taken up with special solutions of problems of too advanced a type for the ordinary mathematical work of a school. These ought, I think, to be there in due proportion, but not to the exclusion of the rest. For instance, at the present time the great problem in a school like this is to get the Geometrical teaching thoroughly done—not the advanced teaching (I mean Casey, etc.), but the ordinary Euc. I.—VI. The chief result of the recent changes is that an additional burden has been flung on our shoulders; namely, teaching geometrical drawing as well as propositions and riders, all to be crowded in two periods of from 40 to 45 minutes a week at best. Now during the whole of the time since the New Geometry has been started there

has been (I believe I am correct in saying) absolutely no assistance from the *Gazette*, which is still mainly concerned with the kind of problem and proof useful for boys who have obtained, or are just about to obtain, scholarships. I have just been looking through the back numbers which I possess, and the impression given is a somewhat wearisome recurrence of more or less fantastic series. I see there is an article on the teaching of Geometry in the current number, but what is the use to anyone who has not been accustomed to use them of the following: "Models of cardboard and string, wire models and hatpins stuck through cardboard have their special uses" (what models, and how made, what uses?). Examples of this might, I think, be multiplied indefinitely.

Mr. C. St. John Shortt, M.A., Sandroyd School, Cobham, writes:

I have been most interested in this March number of the *Gazette* than before. I must confess that most of the contents of previous numbers has been quite beyond me. I have no doubt that it appeals to, perhaps, the majority of the members of the Mathematical Association. But I imagine there is a sprinkling of members who, like myself, are engaged in Preparatory School work, who have little time and perhaps little understanding for learned dissertations on say "Univocal Curves" or "Illegitimate Differentiation." On the other hand, a valuable note like that of Lodge's on "Contracted Methods" in the January number was of great assistance to me, and I really should welcome simpler material of this kind. I think the idea of founding local branches of the Association is an excellent one.

These letters and Mr. Child's paper are exactly the kind of discussions which ought to be encouraged in our *Gazette*. I have never been sanguine that the so-called "reform of mathematical teaching" would leave us much better off than we were before, and the present is an opportune time for discussing such questions. Personally I consider that reform of teaching means something more than mere tinkering with syllabuses, the publishing of school geometries, and the writing off of publishers' losses on the innumerable Euclids that came out just before the change. The teaching of algebra is at present in a hopeless chaos, and the subject has practically all but disappeared from our curricula.

The old kind of useless drudgery which was called algebra is quite unsuited to modern requirements. It disgusted me so with algebra when I was a boy that I lost heavily in every algebra paper in the college and university examinations in my student days. There are many useful things which could be taught to boys under the heading of algebra, but it is impossible to teach things which are not examined on or to examine on things which are not taught, or to teach and examine on things without some text-book as guidance. Here, then, we have another subject on which the opinions of teachers would be valuable, and in order that the discussions may be effectively carried out we must induce the rank and file of the teachers to join the Association.

A few years ago one or two discussions on teaching mathematics were organised in Bangor by Professor Green, and what struck me most about the opinions expressed by those present was the deadly effect of syllabuses in stifling all efforts at originality on the part of the teachers. Unless mathematics is to be taught as a living reality which enters into every problem in the life of the nation, then, I say, we might just as well abolish school mathematics altogether and substitute philately in its place.

I consider that the recent papers on convergent series in the *Gazette* fulfil one very useful purpose. They show the futility of attempting to teach things like the Binomial Theorem to the ordinary schoolboy. But if anyone complains of the somewhat advanced character of the contents of the *Gazette* the Editor will tell him that he is only too glad to get papers and discussions of a more elementary character, but that people will not write them.

There must be a great many teachers who, however hard they are worked, could write *some little thing* in the course of the year to keep the ball rolling now it has been started. It is impossible for one man to keep a ball rolling indefinitely, or even to start it rolling at all when there is a large amount of inertia to overcome, but a little united effort would do much in rescuing the study of mathematics from the despised position which it now occupies in the eyes of the British public.

G. H. BRYAN.

A FIRST PRACTICAL TRAINING IN ARITHMETIC.

THE following practical suggestions are offered as an answer to the question of ever-increasing interest, "How, when, where, shall the child begin arithmetic?"

The importance of the science of number, as a great teacher has shown, is enormous, not only in its relation to the study of abstract mathematics and in its dominance over the prosperity of nations, but in the fact that it is the "conclusive science which we have to apply all our days to all our affairs."

Herein lies the clue towards a right method of presenting it to children. The training which we owe them in this direction must be an eminently practical one, based on active interest in every-day life and surroundings. It will begin as soon as the child's activities need an outlet, and he shows that he is ready for intelligent play.

He will spend two or three years during the earliest stages developing ideas of number up to twenty, by means of varied practice in arranging objects, such as bricks, dominoes, cards. He will gradually become familiar with the coinage by means of a box of "play" money, which he will use to buy and sell in the nursery market. Notions of weight will be learnt from the use of scales, as ideas of length are gained by much practice with foot and yard measures and rules. He will be taught simple games that involve recognition of the number of pips, such as "Grab," "Old Maid," and the easiest form of dominoes. When he shows himself ready, he can be led to transfer his ideas of number to figures.

In the two next stages the same interest is kept up in games, in buying and selling with the coins. He is also introduced to dry and liquid measures in a practical way; his memory and judgment will be exercised in every possible manner as opportunity offers. His limit of number is still twenty; and when he is quite ready he works, entirely with his teacher on the blackboard, every addition, multiplication, subtraction, and division sum (up to twenty), using the necessary arithmetical signs. The use of objects is dispensed with when no longer needed. He next passes on to do the same sums on paper, entirely by himself.

This brings the child to the fifth and sixth stages of his course, when his number knowledge will be increased (by concrete illustration) first to thirty, then to sixty, so that he can extend the working of the sums he already knows, and also the writing out of tables, to these numbers. Then, working from very easy bills, he will learn how to set compound and simple addition and multiplication sums. The process of "carrying" will offer little difficulty after his experience in changing coins in the play-shop keeping, and in the constant use of scales and measures. At this stage a clock face with movable hands will give much useful practice, and teach besides how to tell the time. This will open up interest in time measure, and in diagrams and models to illustrate the daily rotation of the earth and monthly journey of the moon. Opportunities will be seized to welcome practical help from the child, as he is able to give it, in weighing and stamping for the post, in jotting down small outlays, in measuring or counting. Passing on from the relation of certain fractions, *e.g.* $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, to a foot, a yard, etc., diagrams and models will be freely made and used to give clear ideas of fractions of unity.