ELEMENTARY GEOMETRY: ANGLES, PARALELS, TRIANGLES, EQUIVALENT FIGURE, WITH THE APPLICATION TO PROBLEMS, PART I

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J. M. WILSON

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ELEMENTARY GEOMETRY

PART I.

ANGLES, PARALLELS, TRIANGLES, EQUIVALENT FIGURES, WITH THE APPLICATION TO PROBLEMS.

COMPILED BY

J. M. WILSON, M.A.

FELLOW OF ST JOHN'S COLLEGE, CAMBRIDGE, AND MATHEMATICAL MASTER OF RUGBY SCHOOL.

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PREFACE.

THE lately published Report of the Schools Inquiry Commission has given an immediate importance to the question whether Euclid's Elements is the proper text-book for teaching Geometry to beginners. Euclid's recognised and acknowledged faults as a system of Geometry, and as a specimen of analysed reasoning, are of slight importance compared with others of greater magnitude. The real objections to Euclid as a text-book are his artificiality, the invariably syllogistic form of his reasoning, the length of his demonstrations, and his unsuggestiveness.

As to the first, he aimed, not at unfolding Geometry as a science, but at shewing on how few axioms and postulates the whole could be made to depend: and he has thus sacrificed, to a great extent, simplicity and naturalness in his demonstrations, without any corresponding gain in grasp or cogency. The exclusion of hypothetical constructions *may be mentioned* as a self-imposed restriction which has made the confused order of his first book necessary, without any compensating advantage. There is no real advantage in the arrangement of propositions by sequence which Euclid maintains so strictly, for nothing can be gained by excluding *any* sound method of reasoning: and if a direct proof can be found of any theorem, which naturally arises out of the data of the theorem, it is to be preferred to a circuitous proof which depends on other theorems. Thus if the Fifth Proposition can be proved independently, and on its own evidence, it is certain that the decisive bearing of the data on the conclusion will be better appreciated than it would be on Euclid's method.

Again, as his self-imposed restrictions, geometrical and logical, have made his Geometry confused in its arrangement, and unnatural and forced in the nature of his proofs, so too the detailed syllogistic form into which he has thrown all his reasonings, is a source of obscurity to beginners, and damaging to true geometrical freedom and power.

We put a boy down to his Euclid; and he reasons for the first time, a task in itself difficult enough; but we make him reason in iron fetters. There is, of course, a natural and inevitable difficulty in the task of tracing data into the inferences founded on them; the geometrical facts are new: it is new to the learner to find himself reasoning consecutively at all. If then to all this novelty we add the constant analysis into syllogisms of inferences which are obvious without this analysis, and the constant reference to general axioms and general propositions, which are no clearer in the general statement than they are in the particular instance, we make the study of Geometry unnecessarily stiff, obscure, tedious and barren. Many facts perfectly familiar to common sense and experience become strange and unrecognizable when thus expressed; and conclusions the most obvious become cloudy by the extreme detail of the proofs. And the result is, as every one knows, that boys may have worked at Euclid for years, and may yet know next to nothing of Geometry.

The length of his demonstrations is a real evil; for, when a geometrical theorem has become familiar, it is easy to analyse into a demonstration the perception that we have obtained of the certainty of the theorem, but until that familiarity is gained great length in demonstration exercises the memory more than the intelligence. Messrs. Demogeot and Montucci in their Report on English Education begin one of their chapters with the following remarkable words: "Le trait distinctif de l'enseignement des mathématiques en Angleterre c'est qu'on y fait appel plutôt à la mémoire qu'à l'intelligence de l'élève." And they remark later on, "On y trouve (in Euclid) sans doute une logique de fer, qui n'admet point de réplique; mais aussi arrive-t-on aux résultats les plus évidents par un verbiage absolument en désaccord avec nos élégantes habitudes d'une concision non moins vigoureuse que la prolixité d'Euclide." And unquestionably one result of the tediousness of Euclid is that so little knowledge of geometry is gained; so little, there is abundant evidence to prove, that our education is more marked by inferiority to other nations in this respect than in any other.

And again, unsuggestiveness is a great fault in a text-book. Euclid places all his theorems and problems on a level, without giving prominence to the master-theorems, or clearly indicating the master-methods. He has not, nor could he be expected to have, the modern felicity of nomenclature. The very names of *superposition*, *locus*, *intersection of loci*, *projection*, *comparison of triangles*, do not occur in his treatise. Hence there already exists a wide gulf between the form in which Euclid is read, and that in which he is generally taught. Unquestionably the best teachers depart largely from his words, and even from his methods. That is, they use the work of Euclid, but they would teach better without it. And this is especially true of the application to problems. Everybody recollects, even if he have not the daily experience, how unavailable for problems a boy's knowledge of Euclid generally is. Yet this is the true test of geometrical knowledge; and problems and original work ought to occupy a much larger share of a boy's time than they do at present.

On the other side there will be brought two arguments, and in general two arguments alone.

It will be urged that if Euclid is given up we shall lose the advantage of uniformity. Its place will be taken by scores of manuals of Geometry, and examinations in Geometry will become impossible. On such a point it will be difficult to persuade others that the advantage is nearly imaginary. The fact is, that Geometry when treated as a science, treated inartificially, falls into a certain order from which there can be no very wide departure; and the manuals of Geometry will not differ from one another nearly