THE THEORY AND PRACTICE OF MODEL AEROPLANING

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MODEL AEROPLANING

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'HOW TO ADVANCE THE SCIENCE OF AERONAUTICS,'
'HOW TO BUILD A MODEL AEROPLANE,' ETC.

"Model Aeroplaning is an Art in itself"

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PREFACE

THE object of this little book is not to describe how to construct some particular kind of aeroplane; this has been done elsewhere: but to narrate in plain language the general practice and principles of model aeroplaning.

There is a *science* of model aeroplaning—just as there is a science of model yachting and model steam and electric traction, and an endeavour is made in the following pages to do in some measure for model aeroplanes what has already been done for model yachts and locomotives. To achieve the best results, theory and practice must go hand in hand.

From a series of carefully conducted experiments empirical formulæ can be obtained which, combined later with mathematical induction and deduction, may lead, not only to a more accurate and generalized law than that contained in the empirical formula, but to valuable deductions of a totally new type, embodying some general law hitherto quite unknown by experimentalists, which in its turn may serve as a foundation or stepping stone for suggesting other experiments and empirical formulæ which may be of especial importance, to be treated in *their* turn like their predecessor. By "especial importance," I mean not only to "model," but "Aeroplaning" generally.

As to the value of experiments on or with models with respect to full-sized machines, fifteen years ago I held the opinion that they were a very doubtful factor. I have since considerably modified that view, and now consider that experiments with models—if properly carried out, and given

due, not *undue*, weight—both can and will be of as much use to the science of Aeronautics as they have already proved themselves to be in that of marine engineering.

The subject of model propellers and motors has been somewhat fully dealt with, as but little has been published (in book form, at any rate) on these all-important departments. On similar grounds the reasons why and how a model aeroplane flies have been practically omitted, because these have been dealt with more or less in every book on heavier-than-air machines.

Great care has been exercised in the selection of matter, and in the various facts stated herein; in most cases I have personally verified them; great pains have also been exercised to exclude not only misleading, but also doubtful matter. I have no personal axe to grind whatever, nor am I connected either directly or indirectly with any firm of aeroplane builders, model or otherwise.

The statements contained in these pages are absolutely free from bias of any kind, and for them I am prepared to accept full responsibility.

I have to thank Messrs. A. W. GAMAGE (Holborn) for the use of various model parts for testing purposes, and also for the use of various electros from their modern Aviation Catalogue; also Messrs. T. W. K. CLARKE & Co., of Kingston-on-Thames. For the further use of electros, and for permission to reproduce illustrations which have previously appeared in their papers, I must express my acknowledgment and thanks to the publishers of the "Model Engineer," "Flight," and the "Aero." Corrections and suggestions of any kind will be gratefully received, and duly acknowledged.

V. E. JOHNSON.

MODEL AEROPLANING

INTRODUCTION.

§ 1. MODEL AEROPLANES are primarily divided into two classes: first, models intended before all else to be ones that shall *fly*; secondly, *models*, using the word in its proper sense of full-sized machines. Herein model aeroplanes differ from model yachts and model locomotives. An extremely small model locomotive *built to scale* will still *work*, just as a very small yacht built to scale will *sail*; but when you try to build a scale model of an "Antoinette" monoplane, *including engine*, it cannot be made to fly unless the scale be a very large one. If, for instance, you endeavoured to make a $\frac{1}{10}$ scale model, your model petrol motor would be compelled to have eight cylinders, each 0·52 bore, and your magneto of such size as easily to pass through a ring half an inch in diameter. Such a model could not possibly work.*

* The smallest working steam engine that the writer has ever heard of has a net weight of 4 grains. One hundred such engines would be required to weigh one ounce. The bore being 0·03 in., and stroke $\frac{1}{32}$ of an inch, r.p.m. 6000 per min., h.p. developed $\frac{1}{28000}$ ("Model Engineer," July 7, 1910). When working it hums like a bee.

Note.—Readers will find in the "Model Engineer" of June 16, 1910, some really very fine working drawings of a prize-winning Antoinette monoplane model.

§ 2. Again, although the motor constitutes the *chief*, it is by no means the sole difficulty in *scale* model aeroplane building. To reproduce to scale at *scale weight*, or indeed anything approaching it, *all* the *necessary*—in the case of a full-sized machine—framework is not possible in a less than ⅛ scale.

§ 3. Special difficulties occur in the case of any prototype taken. For instance, in the case of model Blériots it is extremely difficult to get the centre of gravity sufficiently forward.

§ 4. Scale models of actual flying machines *that will fly* mean models *at least* 10 or 12 feet across, and every other dimension in like proportion; and it must always be carefully borne in mind that the smaller the scale the greater the difficulties, but not in the same proportion—it would not be *twice* as difficult to build a ¼-in. scale model as a ½-in., but *four*, *five* or *six* times as difficult.

§ 5. Now, the *first* requirement of a model aeroplane, or flying machine, is that it shall FLY.

As will be seen later on—unless the machine be of large size, 10 feet and more spread—the only motor at our disposal is the motor of twisted rubber strands, and this to be efficient requires to be long, and is of practically uniform weight throughout; this alone alters the entire *distribution of weight* on the machine and makes:

§ 6. "**Model Aeroplaning an Art in itself**," and as such we propose to consider it in the following pages.

We have said that the first requisite of a model aeroplane is that it shall fly, but there is no necessity, nor is it indeed always to be desired, that this should be its only one, unless it be built with the express purpose of obtaining a record length of flight. For ordinary flights and scientific study what is required is a machine in which minute detail is of

secondary importance, but which does along its main lines "*approximate* to the real thing."

§ 7. Simplicity should be the first thing aimed at—simplicity means efficiency, it means it in full-sized machines, still more does it mean it in models—and this very question of simplicity brings us to that most important question of all, namely, the question of *weight*.

CHAPTER I.

THE QUESTION OF WEIGHT.

§ 1. THE following is an extract from a letter that appeared in the correspondence columns of "The Aero." *

"To give you some idea how slight a thing will make a model behave badly, I fitted a skid to protect the propeller underneath the aeroplane, and the result in retarding flight could be seen very quickly, although the weight of the skid was almost nil.† To all model makers who wish to make a success I would say, strip all that useless and heavy chassis off, cut down the 'good, honest stick' that you have for a backbone to half its thickness, stay it with wire if it bends under the strain of the rubber, put light silk on the planes, and use an aluminium ‡ propeller. The result will surpass all expectations."

§ 2. The above refers, of course, to a rubber-motor driven model. Let us turn to a steam-driven prototype. I take the best known example of all, Professor Langley's famous model. Here is what the professor has to say on the question § :—

"Every bit of the machinery had to be constructed with scientific accuracy. It had to be tested again and again. The difficulty of getting the machine light enough was such

* "Aero," May 3, 1910.

† Part of this retardation was, of course, "increased resistance."

‡ Personally I do not recommend aluminium.—V. E. J.

§ "Aeronautical Journal," January 1897, p. 7.