

CORRESPONDENCE.

To the Editor of the AERONAUTICAL JOURNAL.

DEAR SIR,—Since Mr. Riach has said nothing nasty about my "Resistance of Air," I suppose I may consider his review as not unflattering.

That the book is controversial is exactly what it was intended to be. It is not a "text book" in the ordinary sense, which is "too often a book whose sole purpose is to enable more or less stupid youths to pose as graduates of a course of mathematics." My little book is of no use to any student whose sole desire is to *pass an examination*. My object is to make the student *think for himself*, whilst the examiner's object is make him think *exactly as he does himself*. Since Mr. Riach admits that it has made him think, the book has, to this extent, succeeded in its object.

Where I join issue with Mr. Riach, however, is where he says that "much of the argument is based on *experimental work*, . . . yet it would appear that such fundamental questions . . . *should be finally settled rather by modern hydrodynamical theory than by any set of experimental results, however complete.*"

Experiment is, *in essence*, a question put to Nature; and Nature never lies. You may not understand the reply—but that is your fault for not having put your question properly. I think it was Professor Armstrong who said that before anyone performed an experiment he should have clearly in his mind *what he wanted to know*, and further, *what sort of a reply he expected to get*.

If hydrodynamics, or aerodynamics, is not based on experiment, what on earth is it based on? Mr. Riach would appear to reply, "on theory," or on hypothesis—? on imagination. But a theory might be popularly described as a scientific cabinet, with pigeon-holes in it, for *containing the facts*, which facts are carefully indexed. As long as the pigeon-holes will admit *all* the facts, the theory may be useful—since science is, *in essence*, "economy of thought." If facts are discovered which *will not fit* in any of the pigeon-holes—*disagreeable facts*—it will be necessary to look out for another cabinet, or "theory," which will hold them.

However, Mr. Riach appeals to Cæsar—to "modern hydrodynamical theory." What is this theory? And how far can we trust that its foundations are reliable?

I suppose that we may say the theory is, chiefly, a vast accumulation of differential equations, concerning the supposed motion of an imaginary fluid, which has some self-contradictory properties. Sometimes the theory agrees with experiment; but equally often it disagrees—sometimes very violently.

If a theory is to be of any use we ought to be able to predict (very fairly) by means of deductions from it. If we ask the theory the following questions, what sort of a reply are we likely to get from it?

1. How do birds sail (or soar)?
2. How are we to calculate the resistance of a spherical shot, moving at any given velocity, in air, or water?
3. What is the *Law* of the Resistance of bodies, moving in air, at a speed of 1,000 met. sec.?

(1) Mr. Mattock says it varies *as the velocity*, or, let us say, as $C \cdot 10^3$.

(2) The theory I support, says that it is as the *square of the velocity*, or $C \cdot 10^6$.

(3) Many authors say that it is as the *cube of the velocity*, or $C.10^9$.

(4) M. Honoré ("l'Illustration"), in his article on the new German gun, says that it varies as *the fourth power of the velocity*, or $C.10^{12}$.

Which is right?—or the most accurate? They may all be wrong; but they are, certainly, *not all right*.

4. How does a fluid move when passing out through a circular hole in a thin wall of a tank?

5. Why do all liquids and fluids move in spirals—say, for example, tea flowing out of a teapot, or the ascending smoke of a cigarette in *very still air*? Mathematically, they *ought to move quite differently*.

6. Why cannot theory show what is the fault of all propellers? If it can, why is their *efficiency* so very low?

I might add considerably to this list, but I will only point out, in conclusion, that it is not *very many years* since "theory"—or, more accurately, the High Priests of the Cult—were inclined to class all those who thought men would ever fly as little better than lunatics.

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