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LEARNING HOW TO FLY.

By C. E. Duryea.

The object of this paper is not to present anything new, but rather to call to attention and to impress upon the mind as deeply and fully as possible a few facts which constitute the key to complete success at flying. Without this key our efforts, time and money will be wasted ; with it success is ours. There need be no longer a question as to our having within our reach all the necessary mechanical features required for flight. We can build machines light enough, equip them with motors powerful enough, and can safely say, " They will fly if properly directed." Right there, however, is the problem. " If properly directed" is an unknown quantity. Solve this and we will fly as soon as the machines and motors can be built. This many admit ; but I fear that even 'they do not fully see the direction from which we must expect help. I fear that they are spending time needlessly in attempts to improve the motor or the machine, or in seeking for some automatic method of managing instead of going directly at work to fly.

The proper way to solve this question is to build a machine and to use it. Use and use alone can fully show its good and bad features, and point out the way to properly remedy them. Practice leads toward perfection ; so, if we expect to do anything properly, we must practice. We learn to walk, talk, write, ride, swim, skate — in short, everything requiring skill is the result of practice ; and flying will be no exception to the rule. Suppose for an instant that we had the most perfect flying-machine of the next century right here before us. Could we use it ? Would we have the practice, skill and increased knowledge necessary to properly manage it ? No. It would be as useless to us as our crudest experiment of to-day. We would succeed in breaking it, and, in all probability, our necks with it, at the first trial. But if we had such a machine, what would be our first duty toward it ? Simply to learn to use it. This, then, is our duty toward the proposed machine of today, for who knows that' it is not as successful a form as we will And ? All around us we see pursuits requiring various degrees of skill to properly follow them ; and among them is one — cycle-riding — which calls for a skill very similar to that required for flying. The cycler must continually guide and continually balance. Is it difficult ? No. Simply because continued practice has given a skill that overcomes the difficulty with ease. Take away one of the wheels, and yet a fancy rider will guide, drive and balance on the other. What can be more unstable than that which rests on a single point ? The expert is able, however, to ride the single wheel where he chooses, even up or" down a flight of steps. Practice and practice alone enables him to do this. I cannot believe that the

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flying-machine will prove so difficult as the single wheel, nor do I see any reason why it should be more difficult than the two-wheeled vehicle now so common. Let us compare it with this. Suppose one of our most modern cycles to he presented to a ruler in Central Africa with the information that it could be ridden and would be found faster than his fastest horses. Suppose that he called together his best men and asked them to lide it under penalty of instant death if they fell off or in any way failed after attempting to ride it. How many do you suppose would make an attempt ? Or, having attempted, would succeed V None. The machine would not be ridden. So it is with our attempts at flying. Those who have attempted have failed with disaster to themselves and machine before they had acquired skill enough to properly manage their creation. This should not, need not be. We do not teach a man to swim by throwing him into deep water and telling him to swim or drown. Instead, we support him with a rope from the end of a pole till he is able to go it alone, till he has acquired confidence and skill. Likewise with the cycle. The pupil is held in position by the

instructor till he balances and steers almost automatically. He is not allowed a chance to fall until he is thoroughly familiar with every movement ; and instead of a nervous beginner, straining every muscle in an effort to do with strength alone the work before him, we have a full-fledged rider who sits easily, rides easily, and accomplishes more than the beginner possibly could, simply and solely because he has the skill. So it will be with the flying machine. We contemplate powerful motors as necessary to drive us through the air at a rate that will cause the air to support us, while the gull and the buzzard, by their skill, take advantage of the air currents and soar for hours without any appreciable work at all. It is the skill rather than the motor that we need. Can we get that skill ? Certainly, by practice, just as the swimmer and rider get it. This is the one thing yet lacking, and to this we should direct our attention. " But, ' ' you ask, " how shall we practice long enough to get this skill if our first attempt ends in disaster and we are unable to make a second?" The answer is simple. Just as the rider and swimmer go to a school for their instruction, so we must go to a flying school for ours. The first swimmer avoided deep water until he had learned enough to venture safely ; the first rider had to take his falls as best he could ; but in these respects they had the advantage over the would-be flyer. If it were not so, in all probability we would have had no swimmers or riders. The flyer must make his first attempt in mid air, and as this is suicidal without protection of some kind, he must be provided with a flying school. In other words, the key to flying is the school. " And what is the school 1" you ask. It is any one of several arrangements for supporting the flyer in mid air, safe from danger but free to practice. There is nothing new in the idea, and I claim no credit for it ; but I do earnestly desire to impress upon my readers the fact that we will never learn to fly without the school, and that we may

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fly at once with it. Sanderval stretched a cable between two peaks and suspended his apparatus from it ; others have used derricks and beams. These devices are good as far as the idea goes, but they are far too limited. The birds do not fly in small circles ; and we, with our proposed large machine and high rate of speed, must soar in still larger circles. I would suggest the use of a captive balloon, held by several widely divergent guy ropes, and preferably over a body of water, so that there would be less gusts to the air currents, and so that a possible fall would not be so risky. From this balloon, by a single rope, suspend the machine and rider so that they would be as free to swing as a plumb-bob. If his machine is provided with a propeller and a means of driving it, the experimenter can practice on " circles" and " figure eights" until he is thoroughly familiar with every detail of the machine and until he manages It almost instinctively. If he finds defects in the design or construction they are not even dangerous, but can be remedied at once and the result noted. A spring scale in the suspending rope would show at a glance what he is doing toward sustaining himself, and whether any change improves the result or not. There is no guesswork about it, but a positive progress can be relied upon. A different rider may try his ability as fast as the one practicing gets tired, and notes and experiences can be compared. Improve the machine as seems best and continue the experiments with those riders who are most apt, and a short while will find them going it alone. This device is superior to others in many respects. It gives the beginner ample room to swing around in, and the room is an absolute necessity for the flying-machine learner. He must move at a good speed if he is to fly at all, and he requires time to think how to act until action becomes a sort of second nature. The atmospheric conditions are better up high, because we thus avoid the gusts and eddies at the surface. Any kiteflyer appreciates this difficulty. If the machine is provided with a motor and operated only on quiet days this disturbance would not be so appreciable ; but as absolutely still days are few and far between, it is not wise to ignore it. If an aeroplane patterned after the suggestions of Le Bris, Mouillard, Lilienthal and others is used, it is almost absolutely necessary to have the aeroplane above the gusts and eddies, for, having no motor, it cannot help itself through them as the bird does by flapping ; and any cycle instructor can tell you how greatly the effort of teaching is increased if the surface of the practicing yard is in poor sliape. Bad conditions will be much more detrimental in the air, because the rider can see the rough places in the ground, but the flyer cannot. When these things are taken into consideration it is really a matter of surprise to me that the experimenters mentioned were as successful as they are reported to have been. The birds

themselves acknowledge this difficulty by flapping oftener when near the ground. How essential, then, that we avoid this unfavorable region in our lessons ; and the most available, if not the only way to do so, is by using the captive balloon. With it we can

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soon get the skill which will enable us to handle with success almost anything that possesses the elements of a flying-machine, just as an expert cycler will ride anything that looks like a cycle and some things that don't.

It is not the purpose of this paper to advocate any special form of machine or to go into its details ; but I would suggest that a machine, bird-like in form, provided with a vertical and horizontal rudder controlled from a handle-bar, and having a propeller ta be driven by the feet of the rider, contains all that is required for a short flight ; and it we should be able to take advantage of the air currents as the birds do it might be all we require for longer ones. Such a machine would be simple, light, not likely to get out of order, and would cost but a few hundred dollars. The captive balloon would cost probably $100 each ascension, which would give several persona one or more short lessons each. On this basis $1000 might suffice to secure actual flight. On the other hand, if many changes should be found necessary in the machine and a motor prove necessary, five or ten times that amount or even more might be required. It matters not, however, if twice $10,000 be required, the solution of the problem is worth many times that amount. Nor need money be difficult to raise. A shrewd advertiser paid $10,000 for a single Columbian half dollar. Surely more advertising would result from having their name connected with a series of flying experiments. Flying is within our grasp ; we have naught to do but take it. And having once wrested from nature the secrets of the birds and achieved actual flight oven with a small machine, capital will rush in and improvements will follow till in a short while the only universal roadway, the air around us, will be in universal use.

DISCUSSION BY PROPESSOR TODD, OF AMHERST COLLEGE.

A friend suggests that criminals, in lieu of treatment by hanging or electrocution, be detailed for duty on flying-machines for the common cause of science and humanity. A man convicted of slaughtering his wife, for example, instead of being forced to edify a handful of curious onlookers with the ghastly spectacle of capital punishment, might be permitted first to receive the coaching of some expert in aerodromics ; then, on the day set for public exhibition, if both machine and aviator go to smash, well and good — the criminal would have had to suffer death anyway, and the builder of the machine would feel compensated by the opportunity for testing his device ; while if the trial succeeded, the gain to the art of flight may be enormous, and the culprit will come down presumably frightened enough to choose a life of virtue forever thereafter.