vessels, mostly destroyers, in the waters of Southern California, where the flying fish *Cypseturus Californicus* abounds. In view of the controversial nature of the supposed "flight" of these fish, I have repeatedly and carefully observed their movements from the advantageously low position afforded by smaller craft. I have also observed them at night under strong lights when netting or spearing them at the ship's gangway for the mess.

It appears quite certain from my observations that the chief impetus for the flight is derived under water, apparently the major portion of the thrust coming from tail movements. When swimming under the light the pectoral fins are little used and mostly folded. Occasionally, when apparently stupefied by the light the fish lie with both pectoral fins half spread in a peculiarly relaxed position. Under the light I have never observed any active use of the pectoral fins in swimming. A single powerful thrust may be given in folding the fins from the open position at rest. In daylight flights as the fish leaves the water, in most but not all cases, as stated by Mills, its wings *appear to move* as if in an effort to fly. The motion is not long continued, only four to six or at most about 20 vibrations being accomplished. While such fin movements are in the nature of flying movements the fins are awkwardly handled and seem woefully inefficient and inadequate when compared to the motion of the wings of birds in flight. The wing motions are more in the nature of the bat's wing action, but vastly slower and of relatively small amplitude. It is my distinct impression that these apparent flying motions are in part a consequence of the body motions in swimming which are sustained after emergence from the water and must be readjusted in adapting their movements to the new medium. There is no question but that a large part of the effective effort of this wing motion is expended in orienting the body and wings for the soaring flight which comprises 95 per cent. of the distance covered. It is not used in gaining altitude. There is also a possibility that the motions serve the purpose of disencumbering the fins of superfluous water in taking to the air. Doubtless the motion accomplishes several purposes at the same time, but it is very doubtful whether any momentum for the flight is gained in this way. Once the wind has been caught and the body oriented the flight is definitely a soaring flight with not the least indication of wing movement. This portion of the flight is much like that of the paper darts used by school boys, with, however, some steering action by wings and tail. The flight continues until the fish recovers from its alarm or until, owing to an improper start, it loses altitude. If the flight is to be resumed the fish, as it approaches the water, lowers its tail and with a series of powerful and rapid strokes of the tail in the water regains enough momentum for a continued flight. The motion of its pectoral fins is usually negligible or entirely missing in this new flight. In some cases the fish has been observed to renew its flight in this fashion three times after its initial "take off." The end of the flight is quite abrupt, the tail drops to act as a brake, and the wings fold as the fish strikes the water. The splash produced is confined to the body impact with the water. The flights appear to be conditioned by disturbances in the water, *i.e.*, the bow or hull of the ship or the ship's bow wave. The "take off" under water thus must be in a direction away from the position from which the disturbance comes. In most cases the flight therefore starts along lines radiating from the bow of the ship or at right angles to the hull. On emergence the direction of flight appears to be determined largely by the wind direction and the initial impulse, the latter being away from the disturbing agent. Since the flight is largely dependent on the wind it is clear that successful flights will be controlled by this factor. If the "take-off" occurs under unfavorable circumstances the flight terminates abruptly. Flights originating on the starboard bow have been observed occasionally to cross the bow and end well off the port bow and *vice versa* under proper wind conditions.

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FLYING FISH

THE recent article by Dr. C. A. Mills on "The Source of Propulsive Power Used by Flying Fish"[1] gives an interesting description of the method of regaining lost flying speed by dipping the tail into the water and lashing with it to attain the velocity for a fresh take-off. Having read of this maneuver, and observed it a number of times, I was surprised at the implication that this feature of the flight is not recognized in the literature of the subject.

In January, 1934, I made the voyage from Woods Hole to Panama on the oceanographic ship, *Atlantis*, in company with C. M. Breder, of the New York Aquarium, and other investigators. Mr. Breder had with him a large assortment of literature on flying fish[2] in which I read of the performance that is described by Dr. Mills. After the initial take-off, the fish glides till flying speed is lost, then dips his tail in the water and sculls with it till flying speed is again

[1] SCIENCE, 83: 80, 1936.

[2] R. E. Dowd, *Aerial Age Weekly*, January 10, 1921, pp. 464–465. W. E. Shoulejkin, *Int. Rev. d. ges. Hydrobiol. u. Hydrographie*, 22: 102–110, 1929. C. M. Breder, Jr., *Copeia*, 4: 114–121, 1930. C. L. Hubbs, *Papers Mich. Acad. Sci., Arts and Letters*, 17: 575–611, 1933; (see also, *Ann. Rept. Smithsonian Institut. for 1933:* 333–347, 1935).

attained. I believe it was generally stated in the papers which I read that two or three such renewals are usual before the fish concludes his flight and submerges.

Instigated by Mr. Breder, I timed several flights with a stop watch, observing from the bow of the boat, but, though I witnessed several of these transient contacts with the water, my position was not high enough to permit a very clear view of the procedure. My best chance to observe the performance clearly was on my return to the north, when flying over the Caribbean Sea in a Pan-American amphibian plane near the island of Cozumel. It was on February 19. The plane was flying nearly into a light southwest wind at about 1,000 feet above the sea. Groups of flying fish, a dozen or so at a time, kept taking off and flying directly into the wind. Presumably the plane frightened them, for in a few minutes I saw enormous numbers take to the air, almost always nearly under us. The flights usually consisted of three or four hops, separated by the brief periods of sculling described above. The over-all time of the flights varied roughly from 6 to 18 seconds; *i.e.*, the single hops lasted about 3 to 5 seconds. At least once I could clearly see the acceleration of the fish during its brief period of sculling on the surface between hops, and once I distinctly saw the undulating wake of the fish's tail, looking like a row of dots on the surface of the water.

The procedure as described seems to be well established, and is an interesting combination of the efficiency of aquatic propulsion and the low resistance attained by airfoil support.

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PROPULSIVE POWER USED BY FLYING FISH

IN my brief note in SCIENCE for January 24 under the above title, I failed to make proper mention of the excellent articles of Dr. Carl L. Hubbs in this field,[1] in which he described the repeated tail lashings by which flying fish renew their propulsive impetus in the course of a compound flight.

In his articles, however, he fails to describe the apparently intentional tail lowering by which the fish is enabled to "taxi" off for another glide without the immersion of more than the tip of the tail. One would infer that the movement is accomplished by a folding of the pelvic fins, which provide lifting power for the rear portion of the body when they are extended in the air. Such folding gives the downward tilt that dips the tail into the water.

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PRESENT STATUS OF THE "GEOLOGY OF NORTH AMERICA"

WHEN the writer undertook to bring out the "Geology of North America" to be published by Gebrüder Borntträger in Berlin, with Professor Erich Krenkel in Leipzig as general editor, it was his conviction that, owing to his lack of knowledge in many fields to be covered, it would be necessary, in order to make the work authoritative, that the principal chapters should be entrusted to recognized authorities in their respective fields. This has been done to such an extent that some thirty geologists agreed to collaborate, most of whom have responded with splendid contributions.

A few of the older collaborators, however, have found it impossible to find the time to write their chapters. The result of this has been an unfortunate delay leading to the fear that these missing chapters, about half a dozen, may not be delivered.

This fact, together with the advice received by the writer from the Regents of the University of the State of New York that, owing to his advanced age, he should restrict himself to his graptolite work and aim to finish that, made it necessary to turn the completion of the "Geology of North America" over to a younger, energetic and competent scholar. Such has been found in Professor Balk, of Mount Holyoke College, who is well known by his studies of batholiths and structural problems both in the east and west of North America.

It is hoped that younger geologists can be engaged for the lacking chapters. Meanwhile Professor Balk will begin to bring out in separate instalments the chapters already finished, after bringing them up to date, in which arduous task the writer is assisting him.

Some of the lacking chapters are of great importance, and this notice should be considered by energetic geologists as an appeal to assist in the work. So many manuscripts of great scientific value have been already received that it would mean an irreparable loss to science if the work should not be completed along the original lines.

Correspondence should be addressed: Professor Robert Balk, Mount Holyoke College, South Hadley, Mass.

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SCIENTIFIC BOOKS

HISTORY OF SCIENCE

A History of Science, Technology and Philosophy in the 16th and 17th Centuries. By A. WOLF, with the cooperation of F. DANNEMANN and A. ARMITAGE. pp. xxvii + 692, with 316 illustrations. The Macmillan Company, New York, 1935. $7.00.

A COMPREHENSIVE history of science is badly wanted. To write such a book, to trace the develop-

[1] Papers of Mich. Acad. Sci., Arts and Letters, Vol. 17, 1932; and Smithsonian Reports for 1932, pp. 333–348.