AERONAUTICS

SECOND ANNUAL REPORT

OF THE

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TOGETHER WITH THE

MESSAGE OF THE PRESIDENT OF THE UNITED STATES

TRANSMITTING THE REPORT

FOR THE FISCAL YEAR ENDED JUNE 30

1916

SECOND EDITION

DECEMBER 6, 1916.—Read; referred to the Committee on Naval Affairs and ordered to be printed, with illustrations

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REPORTS.[1]

[1] Reports 1 to 7, inclusive, published in first annual report.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

MUNSEY BUILDING, WASHINGTON, D. C.

Prof. WILLIAM F. DURAND, *Chairman*,
Leland Stanford Junior University, Stanford University, Cal.
Naval Constructor HOLDEN C. RICHARDSON, United States Navy, *Secretary*,
Munsey Building, Washington, D. C.
Prof. JOSEPH S. AMES,
Johns Hopkins University, Baltimore, Md.
Capt. MARK L. BRISTOL, United States Navy,
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Prof. CHARLES F. MARVIN,
Chief United States Weather Bureau.
Hon. BYRON R. NEWTON,
Assistant Secretary of the Treasury, Treasury Department.
Prof. MICHAEL I. PUPIN,
Columbia University, New York, N. Y.
Brig. Gen. GEORGE P. SCRIVEN, United States Army,
Chief Signal Officer, War Department.
Lieut. Col. GEORGE O. SQUIER, United States Army,
In charge Aviation Section, War Department.
Dr. S. W. STRATTON,
Director Bureau of Standards.
Dr. CHARLES D. WALCOTT,
Secretary Smithsonian Institution.

EXECUTIVE COMMITTEE.

Dr. CHARLES D. WALCOTT, *Chairman*.
Naval Constructor H. C. RICHARDSON, United States Navy, *Secretary*.

Prof. JOSEPH S. AMES.
Capt. MARK L. BRISTOL, United States Navy.
Prof. CHARLES F. MARVIN.
Prof. MICHAEL I. PUPIN.
Lieut. Col. GEORGE O. SQUIER, United States Army.
Dr. S. W. STRATTON.

MESSAGE OF THE PRESIDENT.

To the Senate and House of Representatives:

In compliance with the provisions of the act of Congress approved March 3, 1915 (naval appropriation act, Public No. 273, 63d Cong.), I transmit herewith the Second Annual Report of the National Advisory Committee for Aeronautics, for the fiscal year ended June 30, 1916.

WOODROW WILSON.

THE WHITE HOUSE, *December 6, 1916.*

[Extract from Public Act No. 271.]

In the naval appropriation act (Public, No. 271, 63d Cong.) approved March 3, 1915, the following provision was made for a national advisory committee for aeronautics:

An advisory committee for aeronautics is hereby established, and the President is authorized to appoint not to exceed twelve members, to consist of two members from the War Department, from the office in charge of military aeronautics; two members from the Navy Department, from the office in charge of naval aeronautics; a representative each of the Smithsonian Institution, of the United States Weather Bureau, and of the United States Bureau of Standards; together with not more than five additional persons who shall be acquainted with the needs of aeronautical science, either civil or military, or skilled in aeronautical engineering or its allied sciences: *Provided*, That the members of the advisory committee for aeronautics, as such, shall serve without compensation: *Provided further*, That it shall be the duty of the advisory committee for aeronautics to supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and to determine the problems which should be experimentally attacked, and to discuss their solution and their application to practical questions. In the event of a laboratory or laboratories, either in whole or in part, being placed under the direction of the committee, the committee may direct and conduct research and experiment in aeronautics in such laboratory or laboratories: *And provided further*, That rules and regulations for the conduct of the work of the committee shall be formulated by the committee and approved by the President.

That the sum of $5,000 a year, or so much thereof as may be necessary, for five years is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be immediately available, for experimental work and investigations undertaken by the committee, clerical expenses and supplies, and necessary expenses of members of the committee in going to, returning from, and while attending, meetings of the committee: *Provided*, That an annual report to the Congress shall be submitted through the President, including an itemized statement of expenditures.

LETTER OF SUBMITTAL.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS,
MUNSEY BUILDING,
Washington, D. C., December 4, 1916.

The PRESIDENT:

In compliance with the provisions of the act of Congress approved March 3, 1915 (naval appropriation act, Public, No. 273, 63d Cong.), the National Advisory Committee for Aeronautics has the honor to submit herewith its second annual report, including estimates and recommendations, and a statement of expenditures to June 30, 1916.

In order to carry out its purposes and objects as defined in the act of March 3, 1915, the committee submits herewith certain recommendations and an estimate of expenses for the fiscal year ending June 30, 1918. The estimates in detail were submitted through the Secretary of the Navy.

Attention is invited to the appendixes of the committee's report, and it is requested that they be published with the report of the committee as a public document.

It is apparent to the committee that there is a large amount of important work to be done to place aeronautics on a satisfactory foundation in this country.

Very respectfully,

CHARLES D. WALCOTT,
Chairman Executive Committee.

SECOND ANNUAL REPORT OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS,
MUNSEY BUILDING,
Washington, D. C., December 4, 1916.

To the Congress:

In accordance with the provisions of the act of Congress, approved March 3, 1915, establishing the National Advisory Committee for Aeronautics, the committee here submits its second annual report.

The general report reviews the work of the committee during the past year, and contains estimates for the fiscal year 1918 and certain recommendations for the consideration of Congress. Technical reports covering various subjects under investigation during the past year are submitted as appendices.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

The National Advisory Committee for Aeronautics was established by Congress by act approved March 3, 1915. Under the law, the committee is charged with the supervision and direction of the scientific study of the problems of flight with a view to their practical solution, and the determination of the problems which should be experimentally attacked, their solution, and their application to practical questions of aeronautics. In the event of a laboratory or laboratories, either in whole or in part, being placed under the direction of the committee, the committee may direct and conduct research and experiments in aeronautics in such laboratory or laboratories.

The committee has 12 members, appointed by the President. As authorized by Congress, the personnel of the committee consists of 2 members from the War Department, from the office in charge of military aeronautics; 2 members from the Navy Department, from the office in charge of naval aeronautics; a representative each of the Smithsonian Institution, of the United States Weather Bureau, and of the United States Bureau of Standards; and not more than 5 additional persons acquainted with the needs of aeronautical science, either civil or military, or skilled in aeronautical engineering or its allied sciences.

During the past year there was one change in the membership of the committee, caused by the retirement of Lieut. Col. Samuel Reber, United States Army, who was succeeded on the committee by Lieut. Col. George O. Squier, United States Army, as officer in charge of the Aviation Section of the Army.

The organization of the Advisory Committee, as of October 5, 1916, is as follows:

Prof. William F. Durand, chairman.
Naval Constructor H. C. Richardson, United States Navy, secretary.
Prof. Joseph S. Ames.
Capt. Mark L. Bristol, United States Navy.
Prof. John F. Hayford.
Prof. Charles F. Marvin.
Hon. Byron R. Newton.
Prof. Michael I. Pupin.
Brig. Gen. George P. Scriven, United States Army.
Lieut. Col. George O. Squier, United States Army.
Dr. S. W. Stratton.
Dr. Charles D. Walcott.

RELATION OF WORK OF THE ADVISORY COMMITTEE TO ARMY AND NAVY.

In the course of the past year a number of problems of importance to the Army and Navy have come to the attention of the committee, and steps have been taken toward aiding these departments in arriving at solutions of the problems presented. Report No. 11 on gasoline carburetor design, which has just been prepared, and an investigation of air propellers, which is about to be inaugurated by the committee, will both be of value to the military branches of the Government. In the exercise of its function for securing cooperation the committee has enlisted the interest of the Bureau of Standards in the determination of the characteristics of the materials entering into airplane construction and in particular into the construction of air propellers, and the Bureau of Standards is already engaged on these problems. Through its subcommittee on motive power, the Advisory Committee has effected an active cooperation between the Government departments concerned and the Society of Automobile Engineers, which it is expected will at an early date enable the committee to place valuable information at the disposal of the Government departments and the aeronautic industry in general.

AERIAL POSTAL SERVICE.

At the annual meeting on October 5, 1916, a representative of the Post Office Department was present, at the request of the committee, and informed the committee of the unsuccessful efforts of the Post Office Department to inaugurate an aerial postal service in Alaska and from New Bedford to the island of Nantucket.

It was apparent that, although aviation has made great strides in the past two years, the conditions of both of these routes were so severe as to deter responsible bidders from undertaking this service. After discussion of the entire matter, the committee concluded that the time has arrived when it is perfectly practicable to inaugurate such air service, and recommends to Congress that the Post Office Department be authorized to establish one or more experimental routes, with a view to determining the accuracy, frequency, and

rapidity of transportation which may reasonably be expected under normal and favorable conditions, and therefrom to determine the desirability of extending this service wherever the conditions are such as to warrant its employment.

The Advisory Committee will, if called upon, assist and advise the Post Office Department in the undertaking above recommended.

WORK OF THE COMMITTEE.

During the past year the Advisory Committee has held two meetings—on October 15, 1915, and April 20, 1916. The business transacted at these meetings appears under the various subjects treated in this report. At the meeting on October 15, 1915, the regulations were amended to provide that the secretary of the Advisory Committee, who had been ex officio secretary of the secretary of the executive committee, be made a full voting member of the executive committee. This amendment was approved by the President on October 25, 1915. At the meeting on April 20, 1916, the committee adopted an amendment to the regulations changing the date of the annual meeting to the Thursday after the first Monday in October in order to enable it to give consideration to the preparation of estimates of expenses for the following fiscal year, which are required by law to be submitted by October 15 of each year. This change was approved by the President under date of April 27, 1916.

THE EXECUTIVE COMMITTEE.

For carrying out the work of the Advisory Committee the regulations provide for the election annually of an executive committee to consist of seven members and the secretary, ex officio. The organization of the executive committee, as of October 5, 1916, is as follows:

Dr. Charles D. Walcott, chairman, Secretary Smithsonian Institution.

Naval Constructor H. C. Richardson, United States Navy, secretary.

Prof. Joseph S. Ames, physicist, Johns Hopkins University.

Capt. M. L. Bristol, United States Navy.

Prof. Charles F. Marvin, Director United States Weather Bureau.

Prof. Michael I. Pupin, physicist and electrical engineer, Columbia University.

Lieut. Col. George O. Squier, United States Army.

Dr. S. W. Stratton, Director Bureau of Standards.

The program of work approved by the Advisory Committee was entrusted to the executive committee for execution. The executive committee was directed to consider a program of investigation and procedure intended to carry into effect the purposes of the act creating the Advisory Committee and to report the same with recommendations. The executive committee accordingly held regular monthly meetings throughout the year, and in addition held three special meetings. The reports of work done by the executive committee and its recommendations have been approved by the general committee and are incorporated into this report.

To facilitate the work of the committee the following subcommittees were formed and progress has been made on the general lines indicated in the designations of these committees:

Relation of the atmosphere to aeronautics.
Standardization and investigation of materials.
Aeronautical nomenclature.
Radiator design.
Motive power.
Specifications for aeronautic instruments.
Design, construction, and navigation of aircraft.
Site for experimental field.
Governmental relations.
Bibliography of aeronautics.

TECHNICAL REPORTS.

During the past year, owing to the very limited funds available for the use of the committee, only one contract for a special report was placed. This was for an investigation and report on the subject of gasoline carburetor design. Technical Reports Nos. 8 to 12, inclusive, are submitted herewith as appendixes.

Report No. 8 prepared by the subcommittee on specifications for aeronautic instruments, covers the subject of general specifications for aeronautic instruments. The object of this report is to acquaint manufacturers with the types of instruments required for aeronautic purposes and the conditions to be met in the uses of these instruments in connection with the navigation and operation of aircraft.

Report No. 9, covering the subject of aeronautical nomenclature, was prepared by the subcommittee on aeronautical nomenclature. The subcommittee charged with its preparation very thoroughly investigated the new terms which have come into use with the development of aviation and after consideration of such limited contributions as were available on this subject, and the comments of aviators of the Army and Navy, and of manufacturers, adopted this nomenclature for the purpose of eliminating the confusion that has already come into existence in the use of aeronautical terms. In the preparation of this nomenclature, it appeared unnecessary to define any terms already well established in other branches. Particularly, it appeared unnecessary to define such terms as are familiar to all users of automatic engines; so that the nomenclature adopted by the committee principally comprises terms that are peculiar to, or new in, aeronautics.

Report No. 10 is a preliminary report of progress in the design and construction of a suitable form of muffler for aeronautic engines. This is a rather difficult problem and requires a large amount of experimental work. In this preliminary report it is pointed out that there are other than exhaust noises to be contended with even more difficult of elimination. This special report was prepared and submitted by Profs. H. Diederichs and G. B. Upton, of Cornell University, Ithaca, N. Y., under contract made in June, 1915. As definite results have not as yet been attained, experimental work and investigation will be further pursued during the present fiscal year.

Report No. 11, previously referred to, is a very complete and valuable report on gasoline carburetor design and throws light on a rather neglected subject. This special report was prepared and submitted by Prof. Charles E. Lucke, of Columbia University, New York, N. Y.

Report No. 12, entitled "Experimental researches on the resistance of air," by L. Marchis, professor in the Faculty of Sciences of Paris, is an admirable résumé of the status of experimental research at the present time. It is not an original paper, having been translated from the French by Prof. William F. Durand, a member of the committee.

A report on the "Physics of the air" has been prepared by the subcommittee on the relation of the atmosphere to aeronautics and printed in pamphlet form by the Smithsonian Institution. This report should be valuable to aviation officers, who obviously desire to know the causes of atmospheric phenomena, as well as to practical aviators, as many of the results, especially those given in tables and diagrams, are in form for quick and easy use by the practical pilot. The report as published is an abstract from the complete report of that material which is of special interest to navigators of the air.

GENERAL PROBLEMS.

The problems enumerated in the first annual report of the committee constituted the program of work during the past year. These problems are considered of immediate importance, and will be attacked on a larger scale by the committee as soon as funds are made available for the purpose.

A. STABILITY AS DETERMINED BY MATHEMATICAL INVESTIGATIONS.—The work inaugurated by Asst. Naval Constructor J. C. Hunsaker, United States Navy, on these lines has been extended, and is now being carried on by Prof. A. Klemin, who has succeeded Naval Constructor Hunsaker at the Massachusetts Institute of Technology. Prof. Klemin is endeavoring to reduce this problem to a practical form, which will permit of the determination of the proper proportions of the different elements of the airplane design in order to insure the desired qualities, and it is expected the committee will be able to obtain a report on this work during the coming year.

B. AIR SPEED METERS.—A number of engineers are engaged in solving this problem, and a preliminary design has been worked out at the Washington Navy Yard, and has shown fair results in actual service. Upon the completion of experiments the data relative to same will be available to the committee.

C. WING SECTIONS.—No direct investigation bearing on the improvement of the form of the wing itself has been made, but work of considerable interest has been carried out at the Massachusetts Institute of Technology under the direction of Naval Constructor Hunsaker, and reports have been published in a number of aeronautical papers and in Smithsonian Miscellaneous Collection, volume 62, No. 5, June 30, 1916. These reports include discussions of the advantages to be gained by changing the relations and proportions of the upper and lower wings in a biplane arrangement and also the effects produced in the triplane arrangement. Investigations show

that by giving the upper wing a strong stagger and a larger angle of attack than the lower wing it is possible to obtain practically any desired degree of stiffness longitudinally, and this can be done even without the use of stabilizing tail planes. This contribution places this feature of design in a very satisfactory condition, analogous to that of the design of ships, in which the metacentric height is made to suit the conditions of service. It appears that for general service, and particularly for military service, an airplane having a very moderate longitudinal stiffness and ample controls for modifying the attitude of the machine, combined with proper damping surfaces, affords the most satisfactory solution.

D. ENGINES.—In addition to the investigation of mufflers reported last year, the committee has inaugurated an investigation of the subject of gasoline carburetors, but otherwise, due to the limited funds, no direct investigations have been carried on by the committee. However, the results of the meeting of June 8, 1916, when the committee held an open conference with representatives of several manufacturers of aeronautic engines, have rapidly accumulated, and through cooperation with the Society of Automobile Engineers, through the subcommittee on motive power, the committee is closely in touch with engine development and is cooperating in every manner possible, principally by bringing the War and Navy Departments in close touch with this society, and thereby the manufacturers, so that many of the problems of engine design are already well in hand.

E. PROPELLERS.—Very recently the propeller problem has assumed considerable importance, due to the difficulties experienced with wooden propellers handling large power at high speeds of revolution. This problem has been particularly serious in the air service of the War Department on the Mexican border because of the severe climatic conditions, which have seriously affected the life of the propellers. These problems are principally problems of mechanical construction and not problems of design involving the form of the propellers or their efficiency, and on the latter subject no progress has been made, so far as is known to the committee, and no satisfactory engineering data is available for design purposes.

The committee has just entered into a contract with Prof. William F. Durand, which will be carried out at Leland Stanford Junior University, for an investigation of models of propellers with a view to establishing engineering data for design.

F. FORM OF AIRPLANE.—This has already been referred to under "A."

G. RADIO TELEGRAPHY.—No particular progress is reported on this line, although both the War and Navy Departments have carried on investigations on these lines, and considerable success has been attained in recent experiments in the Army.

The Navy has also experimented at Guantanamo and carried on work at Pensacola. The Bureau of Steam Engineering of the Navy Department has also provided a number of airplane radio sets, and the Bureau of Standards has developed a radio direction indicator which will be given practical trials in the naval service at an early date.

PHYSICAL PROBLEMS.

Besides the more general problems, the following problems of a physical rather than aeronautical nature are of particular interest. These problems were noted in the first annual report, but, owing to the lack of funds, very little progress has been made toward their solution during the past year.

A. NONCORROSIVE MATERIALS.—Investigation of noncorrosive materials at the Bureau of Standards has been continued, but no report is yet available.

B. FLAT AND CAMBERED SURFACES.—No progress is reported.

C. TERMINAL CONNECTIONS.—No additional progress is reported.

D. CHARACTERISTICS OF CONSTRUCTIVE MATERIALS.—This work has been begun by the Bureau of Standards, but no report is yet available.

E. GENERATION OF HYDROGEN.—The Bureau of Steam Engineering of the Navy Department has taken up this work in connection with the installation of hydrogen plants aboard ships, but no report is available.

F. STANDARDIZATION OF NOMENCLATURE.—This subject is covered by Report No. 9, which accompanies this report.

G. STANDARDIZATION OF SPECIFICATIONS FOR MATERIALS.—This subject is an extremely broad one and is being handled by the committee in cooperation with the Society of Automobile Engineers. One prominent manufacturer of aircraft has already developed a very good set of specifications for his own use, but these specifications are more or less particular in form, because of the present unusual condition of the material market.

H. BIBLIOGRAPHY OF AERONAUTICS.—Negotiations are under way for the issuance of a report bringing this subject up to date.

I. COLLECTION, REVISION, AND ISSUANCE OF REPORTS covering the state of the art of aeronautics have not been undertaken as it now appears probable that it will be unnecessary because of the number of good publications which already exist.

J. LIMITATION OF SIZE.—No steps have been taken by the committee toward the solution of this problem. An interesting article on this subject by F. W. Lanchester, member of the British Advisory Committee for Aeronautics, is noted in the Scientific American of June 3, 1916.

K. CAUSES OF ACCIDENTS.—Although this problem is a serious one, the committee has not been able to inaugurate the work proposed.

CO-OPERATION WITH AERONAUTIC INDUSTRY.

At the meeting of the executive committee on May 11, 1916, an important step was taken when it was decided to invite representatives of different aeronautic engine manufacturers to be present at a meeting of the executive committee, to discuss the engine problem the committee with a view to bringing out clearly the difficulties encountered by manufacturers in meeting the exacting demands of aviators and with a view to a more complete understanding between the builders and users of aeronautic engines. Accordingly, the executive committee held a public session on June 8, 1916, at which were present representatives of various manufacturers of aeronautic engines and

in addition to the members of the committee representing various Government branches, there were also present, on invitation of the committee, special representatives of the War and Navy Departments familiar with the practical problems involved in the use and development of aeronautic engines. The Naval Consulting Board of the United States was also represented.

The proceedings of this meeting, being of great interest to the aeronautic industry in general, have been given wide circulation by the committee. One of the results of the meeting has been the inauguration of an important movement for the development of satisfactory aeronautic engines. This will undoubtedly serve to stimulate cooperation between the Government departments—the principal users of aircraft at present—and the principal producers of aeronautic engines. Thus, the Advisory Committee has already inaugurated one of the most important services for which it was established. Through the agency of the thoroughly established organization of the Society of Automobile Engineers, many of the steps which impeded progress in the development of the automobile should be avoided in the further development of the aeronautic engine, and powerful and competent agencies brought to bear to aid in the solution of difficult problems.

From such information as the committee is able to obtain, it now appears that the aeronautic engine problem, which was in an unsatisfactory condition a year ago, has greatly improved.

STANDARDS OF WORK.

The Government agencies fully appreciate the necessity of the adoption of standards of work and are taking steps toward the securing of such standards. It is of the greatest importance that the manufacturers of aircraft should work in harmony with the Government, at present the principal consumer, and that they should come to definite agreements as to the standards of work necessary to facilitate production and repairs. The committee, through the subcommittee on motive power, is assisting in this work of cooperation.

EXISTING FACILITIES FOR AERONAUTIC INVESTIGATIONS IN GOVERNMENT DEPARTMENTS.

Limited facilities for aeronautic investigations in Government departments were reported in the first annual report, and it is anticipated that extensive additions to the existing facilities will be developed during the year 1917.

QUARTERS FOR THE COMMITTEE.

In the appropriation for the expenses of the committee for the fiscal year 1917, provision was made for the rental of quarters. The committee reports that quarters in the Munsey Building, adequately meeting the needs of the committee at present, have been secured. However, the increase in work contemplated by the committee, and authorized in the last appropriation, will require additional office space, and the committee recommends that the amount for office rent be increased as indicated in the estimates of expenses for the next fiscal year.

FINANCIAL REPORT.

Out of the appropriation of $5,000 for the expenses of the committee for the fiscal year 1916, the committee reports expenditures and obligations during the year amounting to $4,904.28, itemized as follows:

Expenditures and obligations incurred under appropriation "Advisory Committee for Aeronautics, 1916."

Traveling expenses	$862.70
Furniture and equipment	363.57
Printing	419.60
Stationery	52.42
Telegrams	5.99
Clerical services	1,200.00
Special report (Carburetor investigation by Prof. Charles E. Lucke, of Columbia University, New York, N. Y.)	2,000.00
Total	4,904.28
Balance turned into Treasury	95.72
Amount of appropriation	5,000.00

ESTIMATES AND RECOMMENDATIONS.

The following estimates of expenses for the fiscal year 1917–18 have been submitted by the committee in due form:

For scientific research, technical investigations, and special reports in the field of aeronautics, including the necessary laboratory and technical assistants; traveling expenses of members and employees; rent (office in the District of Columbia not to exceed $1,500); office supplies, printing, and other miscellaneous expenses; clerks; draftsmen; personal services in the field and in the District of Columbia: *Provided*, That the sum to be paid out of this appropriation for clerical, drafting, watchmen, and messenger service for the fiscal year ending June thirtieth, nineteen hundred and eighteen, shall not exceed $12,000; in all, $107,000.

It is strongly recommended by the committee that the next appropriation for the direction and conduct of research and experiment in aeronautics, and the committee's work in general, be made in lump sum with limitations only on clerical and drafting services and office rent in the District of Columbia.

For the fiscal year 1916–17 there was appropriated $85,000, as follows, which became available August 29, 1916:

Traveling expenses of members and employees		$2,000
2 technical assistants, at $2,500 each	$5,000	
1 clerk	1,500	
1 clerk	1,000	
1 draftsman	2,000	
1 draftsman	1,000	
2 laborers, at $660 each	1,320	
8 mechanics, at $1,200	8,600	
		15,420
Rental of office		1,200
Supplies		7,800
Special reports		5,000
Movable combination field office, machine shop, dynamometer shed, hangar, and power plant		15,000
Dynamometer carriage and truck		18,000
Airplane, including motor		10,000
Transmission dynamometer		1,000

Ripograph	$1,000
Stabilizer	1,500
Anemometers, barographs, inclimometers, incidence indicators	1,500
Miscellaneous supplies, spare parts for operation of field plant	5,580
Total	85,000

Owing to the many changes that have occurred in the rapid advance in the development of the art of aeronautics, it will be necessary to obtain further authority before a considerable portion of this appropriation can be used to the best advantage. The committee therefore also recommends that authority be granted to expend any remaining balances of the appropriation for the fiscal year 1916–17 under the same terms recommended for next year's appropriation. This would leave the committee free to use its funds in the most effective manner and transmit to Congress an itemized account of expenditures in its annual report.

CONCLUSIONS.

The carrying on of the work authorized in the last appropriation depends largely on the availability of a suitable field for the location of the field laboratory and its equipment. In the last appropriation for the War Department Congress authorized the securing of fields for Army purposes, and the War Department has called on this committee for its advice respecting the conditions governing the selection of a suitable site for a proving ground for aircraft.

It seems to the committee that considerable advantage would be gained if the site selected for the War Department would also be such as to be suited to the requirements of this committee, as well as to the Navy Department, and, with this purpose in view, the committee has solicited the advice of both the Navy and War Departments in this matter. As a result the committee has been able to advise each as to the requirements of the other and of this committee in the location of such a proving ground, and the site finally selected by the War Department met with the approval of that department and of this committee. Neither this committee nor the Navy Department has authority or funds available for purchasing a site, the War Department only having authority and funds.

It is contemplated that a part of any site selected by the War Department may be made available for certain uses of the Navy Department and of this committee, or, if this is not approved, additional territory adjoining the War Department site can be obtained for these purposes.

The committee strongly recommends that the activities of the War and Navy Departments and of this committee on these lines should be carried out in as close proximity as is possible, to their mutual interest and the advantage of the Government.

The site contemplated by the Army is on a branch of the Chesapeake Bay, sufficiently remote from the entrance of the bay to insure reasonable immunity from interference due to the operations of a possible enemy. The location is such as to be readily accessible to Government officials located in Washington who have the direction of the important developments contemplated. It is also reasonably accessible to the principal manufacturing centers of the East, and

therefore to the principal manufacturers who are interested in the production of the devices necessary to the War and Navy Departments.

The climatic conditions are temperate and well suited to the purposes intended, permitting of work all the year around. The location is also such as to afford unusual facility for the development of aircraft and their accessories suited to work on land and water under nearly all conditions which must be met in service. This feature alone makes it very desirable from the point of view of both the War and Navy Departments, as the development of aircraft suited to operation from rough water is one of the most important problems requiring solution in both services.

The committee feels that if the activities of the War and Navy Departments and of this committee can thus be concentrated at or near one station the greatest good will result, and therefore recommends that in the legislation for the War and Navy Departments and for this committee everything that would tend toward the accomplishing of this concentrated effort be given the most careful consideration.

Respectfully submitted.

WILLIAM F. DURAND, *Chairman.*

TECHNICAL REPORTS

OF THE

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

REPORTS Nos. 8 TO 12.