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One of the 16-inch guns on barbette carriage, model 1919, that guards New York City. This type is the largest constructed for seacoast defense. Its equipment consists of electric motors operating through speed gears for elevating, traversing and loading, and an electrically driven air compressor for operating the breech block and purging the bore. Maximum range with a charge of 850 pounds of powder and a projectile weighing 2340 pounds is over 31 miles. A rate of fire of one round per minute can be maintained with this equipment. In his Annual Report for 1924, the Chief of Coast Artillery states "No change has been made during the past year in the project for mounting 16-inch guns on barbette carriages in our harbor defenses. Of the twenty-eight 16-inch guns for which locations have been approved, four have been mounted and two are being mounted. Construction of the emplacements for four additional guns will be started during the coming fiscal year and preliminary plans for the emplacement of fourteen guns are being prepared by the Corps of Engineers. No action has been taken as yet regarding emplacement of the remaining four guns of the project. The necessary 16-inch guns to complete the project are on hand. Six carriages are now in storage awaiting shipment and two more will be completed and ready for shipment by the end of September, 1925."

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National Policies Towards Latin America

A lecture delivered by Prof. J. Q. Dealey of Brown University, at the Naval War College

Revolt of the Latin Colonies

WHEN the thirteen colonies of the United States through revolution won their freedom from Great Britain, the autocracies of Europe correctly foresaw that the contagion of revolutions would spread. Spain warned France of the danger of helping revolutionaries and feared the effect of a successful revolution on its own colonies. Within ten years after peace had been declared, France was in rebellion against its king and before long all Europe was in turmoil. In the years 1807-8 Napoleon invaded Spain and Portugal, placing his brother Jerome on the throne of the former country.

The Spanish American colonies, so long exploited by Spain under its monopolistic colonial policy, seized the opportunity one after the other to revolt, at first ostensibly against the usurper on the Spanish throne, but finally against Spain itself, with the declared purpose of becoming independent states. In 1815 the royal family of Portugal fled to its great colony Brazil and established there a kingdom. In 1822 the ruler returned to Portugal and Brazil declared its independence, organizing as an empire and remaining so until 1889, when the Emperor Dom Pedro was deposed and a Republic established. Meantime in Spanish America, chiefly under the leadership of San Martin in the south and Bolivar in the north had been established (1) the Argentine Confederation including Uruguay and Paraguay, (2) Chile, (3) Peru including Bolivia and (4) Colombia

including Ecuador and Venezuela. In Central America a Federation was formed in 1821 and declared its independence. The great domain of Mexico after fighting for freedom since 1810 freed itself from Spain in 1821. For a few short months it was an empire under Iturbide, but became a Republic after his abdication, March 19, 1823. In the West Indies, the Blacks in Haiti-San Domingo had become free early in the century (1804). Even in Cuba the revolutionary spirit was stirring, but was vigorously suppressed by Spain.

As Spain relaxed its grip on its mainland colonies, both Great Britain and France became deeply interested in the possibility of taking that country's place in the Americas. Napoleon's dream of colonial empire ended when he sold Louisiana to the United States, but England sought to build up commerce with the newly revolted colonies and had designs on the southern part of South America and in the region of the Caribbean.

Attitude of the United States

Among our early statesmen, Jefferson and Hamilton had the clearest vision of the coming freedom of Latin America and the identity of interests in all the Americas, and Jefferson also saw how deeply our national interests were involved in the Caribbean. Presidents Madison, Monroe and John Quincy Adams were in full sympathy with his point of view, and Henry Clay, of the younger generation, became an ardent advocate of the revolting Latin colonies, urging upon our government the policy of recognition and friendly cooperation. Consequently when there came a crisis in the situation at the close of the Napoleonic wars, our political leaders comprehended the significance of the occasion and after careful deliberation formulated the Monroe Doctrine.

The crisis in question was due to the fact that the autocracies of Europe had formed a so-called Holy Alliance for the purpose of suppressing revolutionary movements and restoring revolting colonies to their legitimate monarchs. The Holy Alliance among other objects had authorized France to bring into submission the Spanish colonies, even though the chief of these had been recognized by the United States in 1822. The Alliance assumed that England would offer no objection to this design, but England had no desire to see Spain resume control over its former colonies with which it had developed a most profitable trade, nor did it wish to give France an opportunity to gain territory in the Americas in return for services in suppressing revolts. It, therefore, secretly opened up negotiations with the United States looking towards a common policy in behalf of the Spanish colonies and against the plans of the Holy Alliance.

At first the offer seemed good to Monroe and his advisers. It meant an Anglo-American agreement against European aggressions and the linking of the Americas with the Mistress of the Seas. But England was not willing to join the United States in the recognition of the revolting states, and it became obvious that in the combination the United States was to play a subordinate part to Great Britain. Towards the close of the year 1823 both nations had lost interest in joint action. England on its part secretly notified France (October) that it was opposed to the plan for the subjection of the Spanish colonies, so that France cancelled its agreement with the Holy Alliance, knowing that no expedition could be sent out against the wish of the dominant sea power. The United States on its part also determined to act independently and in consequence Monroe in his message to Congress on December 3rd announced the Monroe Doctrine.

The Monroe Doctrine

The essential aspects of this policy are well known. It asserts the principle of a separation of political interests between Europe and the Americas and that henceforth the Americas are no longer to be considered open to colonization. From these principles it follows that the European powers should not be permitted to add to what possessions they had in 1823, and that in the future the Americas will determine their own policies and will allow no interference from Europe in American affairs. In other words, the United States as the oldest and most important power on this continent, for its own peace and safety, will see to it that European politics and territorial expansion find no place for expression on the western continent. America is to be for Americans, who will work out their own political systems, determining for themselves their own policies without asking advice from Europe and, conversely, will remain politically isolated from European politics.

Our opposition to the designs of the Holy Alliance was relatively insignificant as compared to England's, but the significance of the American announcement was readily grasped by the European powers. England itself was not sympathetic with our assumption of leadership on this continent and least of all with our declaration of opposition to European expansion in the Americas. On this side of the Atlantic, however, the message met with a hearty reception, both north and south, and in the United States the policy indicated has remained fundamental throughout the last hundred years. As President Cleveland said, "It was intended to apply to every stage in our national life and cannot become obsolete while our Republic endures. . . ."

For the next generation after the promulgation of the Message Europe had its own internal troubles and paid only spasmodic attention to the Americas. This neglect strengthened the position of the United States which also was steadily increasing in wealth and population. The chief tests of the Doctrine came in connection with British expansionist movements in Central America and the Panama region in the forties, and with France when during our Civil War it sought a foothold in Mexico. The first was settled by compromise through the Clayton-Bulwer treaty of 1850, supplemented by the Dallas-Clarendon treaty of 1856, and the second complication was ended when Napoleon III accepted our urgent invitation to withdraw his French troops from Mexico.

The real strength of the Policy was tested in the decade 1894-1904 when the Doctrine was made basal for the arbitration of the British-Venezuela boundary dispute and for the warning given Germany against its apparent attempt to gain foothold in Venezuela in 1903. From that time forth it has been clearly understood throughout the world that the power and public opinion of the United States are strongly behind the Monroe Doctrine and that no foreign power can violate its principles except at the risk of war. In consequence, the Latin states to the south, notwithstanding their weakness and our inadequate military preparation, have been guarded by a President's message as effectively as though they were protected by a powerful army and navy. How effective this defense has been may best be seen by contrasting the fate of Africa, fought over and partitioned among the Powers, or of Asia and more especially China, humiliated and exploited by the Powers. Had it not been for the Monroe Doctrine, South and Central America, and Cuba and Mexico besides, would long since have been the battle grounds of the nations and strongly fortified bases near our shores under non-American flags would have compelled the United States to maintain opposing fortifications against the danger of attack. Under such conditions the United States could not have built and controlled the Panama Canal as at present. The situation of the Suez Canal in the midst of international rivalries for supremacy in the Mediterranean is in marked contrast to the peaceful status of the Panama Canal, built by American money, defended by American forces only, and kept free from menace by our domination in the Caribbean region. As long as the United States retains the Monroe Policy and is prepared to enforce it against foreign powers eager to expand their territories at the expense of the Latin states, a *pax Americana* may be assumed, since, even though a foreign power should make war against an American state and defeat it, the

United States would see to it that the terms of victory involved no surrender of territory or sovereignty to that foreign power. But what foreign power would care to make war, if the fruits of victory would never include the accession of additional lands?

It may, however, be said that whatever protection the Monroe Doctrine has been in the past against European Powers, it has not protected the Latin states against the aggressions of the United States itself, and that that is the real danger to their territorial sovereignty. This situation is in fact a problem distinct from that of the Monroe Doctrine. The essential point is that the Monroe Doctrine, primarily for our own sake, aims to keep non-American powers from gaining foothold on this continent and that object surely has been attained. The relations of the American powers among themselves form a separate problem that logically should be considered by itself. So far as the United States is concerned, it involves a consideration (1) of our expansion at the expense of other American powers, (2) of our Caribbean Sea Policy and (3) of the problems of Pan-Americanism.

Imperialistic Expansion of the United States

It is unquestionably true that the territorial expansion of the United States has aroused serious misgivings among our Latin neighbors. The annexation of Texas in 1845 and the seizure of territories from Mexico at the close of the war with that country form the chief basis for charges against us as an imperialistic nation. But in addition there are the Filibuster attempts against Central America and Cuba in the fifties, our retention of Puerto Rico and of a sort of protectorate over Cuba at the close of the Spanish War, and our obvious attempts to dominate the states of the Caribbean, including Mexico, throughout the last quarter of a century. The Panama episode, our actions in Santo Domingo, Haiti, Nicaragua, and in Mexico itself since 1911 are all held against us as illustrations of an ambition to extend our sovereignty southwards at the expense of the sovereignty of over half of the Latin states, and the charge is made that we keep Europe out that we may the more effectively extend our sovereignty from the Gulf ultimately to Cape Horn. The suspicion that we entertain such an ambition is widely prevalent in Latin America and acts as a bar to the promotion of closer friendly relations. As far as the events of the first seventy years are concerned, down to 1893, the matter is closed and history must decide on the justice or injustice of our actions during that period. But beginning with 1894 new situations developed and these are still part of a series of debatable problems and make up in general our present Caribbean Sea policy.

Caribbean Sea Policy

Cuba. In origin this policy goes back to our deep interest even in our earliest years in the trade of the West Indies and also to our interest in the many transfers of sovereignty in that region brought about by the wars of the 18th century. During the Napoleonic wars we were in constant fear lest either powerful France or England should seize Cuba from decrepit Spain, and this dread was accentuated when through our purchase of the Floridas as well as of the mouth of the Mississippi, we became half owners of the shores of the Gulf of Mexico. Unquestionably in those days we had a strong desire that Cuba might come under our own flag as our best safeguard against its seizure by France or England. This hope was especially manifest in the fifties when we sought to purchase the Island from Spain and were suspected of fomenting filibustering expeditions against Spain's sovereignty.

In 1898 when we declared war against Spain because of the situation in Cuba we feared lest we should be charged with ambitious designs, so that as a guaranty of good faith Congress adopted a self-denying resolution known as the *Teller Resolution,* which reads:

> "that the United States hereby disclaims any disposition or intention to exercise sovereignty, jurisdiction or control over said Island except for the pacification thereof, and asserts its determination, when that is accomplished, to leave the government and control of the Island to its people."

The Platt Amendment of 1902 specifies the final agreement made with Cuba, recognizing its independence but reserving a naval base and the right to interfere so as to insure stability in government.

Our interference in Cuban affairs was based on the theory that Spanish government in Cuba had become so corrupt and incompetent that it made inevitable a chronic condition of insurrection, so that in consequence the situation in that Island had become an international nuisance, the abatement of which devolved on us as a near and powerful neighbor and the chief sufferer. This became a few years later President Roosevelt's theory of "international police power," under which by interpretation the United States may assume a sort of guardianship over neighboring nations and see to it that they do not become international nuisances. The first application of this under Roosevelt had reference to the proposed Panama Canal.

The Panama Canal. The project for a Canal on the Isthmus had been under discussion even in the early years of the Spanish conquests of the 16th century. It was revived through the explora-

tion of that region by Alexander von Humboldt early in the 19th century and became a dream of Bolivar's, who hoped to make Panama the Corinth of America. In the forties Great Britain sought to gain foothold in the canal regions of Nicaragua and Panama and thereby came into competition with the United States, which had developed a keen interest in that section because of its recent annexation of Texas and its conquest of California. Friction developed so rapidly that it resulted finally in the compromise of 1850, in which the two countries pooled their canal interests on a fifty-fifty basis—an excellent solution of the conflicting interests involved, but one that seemed to be in violation of the principles of the Monroe Doctrine. In 1879 a French corporation started operations for the building of a canal but became bankrupt ten years later through mismanagement, though it was able to extend its concession from Colombia to the year 1904. Meanwhile the United States had been slowly reaching the conviction that any canal should be "an American canal built with American money" and the results of the Spanish War made this conviction definite. Before this could be done, however, it was necessary to persuade England to waive its rights under the Clayton-Bulwer treaty of 1850 and this was effected through the skillful diplomacy of John Hay in the Hay-Pauncefote treaty of 1900-1901.

The Panama Revolt. Meanwhile French rights in the Panama concession had been bought out and negotiations opened with Colombia for its extension and enlargement. With this state we could not come to terms owing to limitations in its constitution, but queerly enough a revolution broke out in Panama just at that time, whose revolutionary government we promptly recognized, refusing to allow Colombia the privilege of trying to suppress the revolution, and within a comparatively short period we had negotiated with the new state our Canal Zone Treaty. Roosevelt in his justification of this policy, asserted that Colombia was standing in the way of world interests and hence had become a sort of international nuisance, thereby forfeiting its rights. In other words, it got in the way of the steam roller and had to be pushed aside. In 1922, however, the United States in recognition of its obligations in the matter appropriated the sum of 25 millions of dollars in compensation for Colombia's wounded pride and territorial losses, and since that state accepted the treaty based on this offer the incident officially is closed.

Santo Domingo and Haiti. In continuation of the same general policy, President Roosevelt in 1905 submitted a treaty with Santo Domingo under the terms of which the United States would

act as receiver for that nation, taking charge of its receipts and paying its debts from these, so as to keep it free from foreign complications. The Senate refused sanction to this treaty but the President put it into effect on his own responsibility and two years later the Senate acquiesced in the situation by ratifying a treaty. In 1916 marines were landed on the Island so as to maintain order and on November 29th Rear Admiral Knapp declared the country temporarily under military rule. The Harding-Coolidge administration has modified this policy, so that once more native civil authorities are in charge, July 12, 1924, and the marines are to be gradually withdrawn from the Island. A United States Receiver General of Dominican Customs is still in charge and the national debt of that country is rapidly being reduced.

In Haiti a similar situation arose when Admiral Caperton landed marines on July 29, 1915, this being followed by the organiation of a military government under naval authority, designed not to supersede but to cooperate with the civil authorities. Naturally native civil authority was minimized under the circumstances, so that for all practical purposes Haiti, like Santo Domingo, was under the control of armed forces. Under the newer policy of the present administration the marines are slowly being withdrawn from Haiti also and the civil government is functioning more vigorously under the general supervision of the American Receiver General of Customs.

Central America. Without going into detail a somewhat similar policy is in effect in respect to Central America. Nicaragua especially has received attention because of its possession of a future canal site. In 1912 marines were landed in that country and are still maintained there so as to keep order, and this was followed by the Bryan treaty securing to the United States the right to build a canal and a lease of certain islands and Fonseca Bay for a naval base. This treaty aroused much indignation in Central America, especially in Costa Rica and El Salvador and Honduras. The claims of these states were brought before the Central American Court of Justice and endorsed by decision, but both Nicaragua and the United States refused to abide by the decision and this action virtually put an end to the Court's authority.

In general, our newer attitude towards Central America since the Great War is that its several states must turn from revolutions and settle down to a strict compliance with constitutional forms. We recognize no President who attains the office by unconstitutional methods and strongly discourage despotic methods of government or useless wars between the several states. To this end a Central

American Conference was held at Washington in 1923 designed to harmonize the states in general policy. Its conclusions in the form of a general treaty of peace and amity, supplemented by eleven conventions providing for the reestablishment of the General Court and for the limitation of armaments, have already been ratified by Guatemala and Nicaragua, and if finally adopted by all should result in the slow elimination of discord and the substitution of discussion and arbitration for perennial revolutions and petty wars.

Mexico. In harmony with the same general policy, the somewhat harsh terms of Secretary Hughes' earlier demands on Mexico as a prerequisite for recognition were later modified in such way that Mexico could accept them without loss of face. In consequence full diplomatic relations have been resumed, claims for damages are being settled through a Commission, and formal expressions of good will have been exchanged. When the Huerta rebellion broke out, the United States showed its good will to Mexico by selling military supplies to the government and forbidding the exportation of such to the insurgents, a procedure also followed lately in the case of Cuba.

In this development of affairs in the Caribbean, it has become obvious that the United States is definitely committed to the policy (1) of allowing no rival nation to get a military foothold in that region, and (2) of demanding that the states within the Caribbean maintain constitutional forms of government, fulfill their international obligations, and enter upon policies of economic cooperation and political amity. Repeatedly in late years our Presidents and Secretaries of State have affirmed that the United States has no designs against the territories or sovereignty of the Caribbean states and that it will gladly withdraw from its self-imposed mandates, whenever the peoples of subordinated states show definitely their capacity to maintain stable and peaceful governments. The "big stick" and the use of international police power are intended only for "international nuisances" and complete sovereignty awaits them when they cease to be nuisances and perform their obligations. The aim of the United States therefore is not to use its power for conquest and annexation, but rather as a means to emphasize its determination to insist on constructive policies on the part of the Caribbean states. Yet implicit in our policy is also the determination that within the region of the Caribbean peace and safety for all can best be assured by the leadership of the United States in warding off any attempts of foreign powers to gain new or added foothold in that region.

Pan-Americanism

In late years Pan-Americanism has had a remarkable development. The enthusiasm a hundred years ago for a close and lasting fraternalism among all American states weakened at the failure of Bolivar's Panama Congress in 1826 and disappeared entirely in the forties and fifties owing to our attitude towards Mexico, Cuba and Central America. After the Civil War there came a slight revival of interest in a closer relationship among the states of the Americas and this was brought into a formal existence by the organization of what we now call the Pan-American Union, through the agreements of the First Pan-American Congress of 1889. Since that time other congresses have been held at Mexico, Rio Janeiro, Buenos Aires and Santiago (1923) and the next Congress is to be held at Habana within the next five years. These congresses in themselves are important since they unitedly form an American League of Nations, for the purpose of joint discussion over common problems and for the formulation of common policies such as that of arbitration, as illustrated recently by the reference to the President of the United States of the controversy between Peru and Chile over the Tacna-Arica question. The real importance of these gatherings, however, lies in the fact that, through their authorization and the administrative help of the Pan-American Union, the 21 states of the Americas have developed numerous agencies and specialized congresses authorized to carry on matters of general and particular importance. These to a large extent seek to work out common economic and juridical problems, but in late years they increasingly devote themselves to the problems of science, health, and education and seek to bring together socially the peoples of the several nations. Social welfare is the latest addition to the long list of subjects emphasized, thereby bringing into cooperation those interested in such movements as child welfare, the Red Cross, and feminist and labor movements. All this implies that the Americas in finding so many points of common interest tend to neglect their differences and to come to an appreciation of one another's attitudes of mind. It is the most hopeful indication of the dream of a hundred years ago, that all Americans, north or south, should realize how closely they are united in interests. As states eager to maintain on the western continent the principles of an American system based on republican forms of government, all should unite fraternally in support of the principle that on this continent the nations plan to live at peace with their neighbors, recognizing one another's equal sovereignty, and stressing the thought of mutual helpfulness in time of need.

In pursuance of our desire for Pan-American unity many of our leading statesmen have visited and spoken in Latin America, or in public addresses in this country have sought to strengthen friendly relations. The addresses of Presidents Roosevelt and Wilson especially, and Secretaries Root, Knox, Bryan and Hughes, met with marked favor and did much to strengthen fraternal relations. The friendly visit of our fleet under Admiral Caperton to South American ports in 1917 added to the growing friendliness to the United States, and the Naval Mission recently sent to Brazil under Admiral Vogelgesang, though at first it aroused apprehension on the part of Argentina, is now being estimated correctly as a friendly act for Brazil without any thought of hostility against other states.

Not the least of the many influences that make for friendly relations is the strong interest taken in spreading the study of Spanish in the schools and universities of the United States, and in the encouragement given to the use of English and the coming of Latin American students to our American schools. Education and leadership in those countries are closely associated, so that more cordial relations in the future are bound to come, as a younger generation, largely trained in the United States, takes the leadership in the nations to the south. All in all the Pan-American movement is under full headway and seems likely to have a profound influence on the destinies of the Americas in future years.

The League of Nations

A perplexing problem arises from the fact that the Latin states are members of the League of Nations and rejoice in the added dignity and prestige they enjoy through their participation in world politics. Most of these states entered the League on the supposition that they were following the lead of the United States, but some may have joined the League as a possible defense against the United States should it prove aggressive and imperialistic.

There surely is danger that Latin American problems may be brought before the League for action, for obviously the affairs of member states must receive the attention of the League irrespective of the objections of a non-member state—the United States, with its special policies in the Caribbean and the Americas. This possibility is an additional reason why the United States in its dealings with its neighbors should deal fairly and intelligently with them. The Golden Rule is still our policy and the Latin states with their political idealism respond readily to its principles. If our policies are just and generous it is not likely that friction will arise between

us and the League in respect to the Latin states; if on the contrary we do become imperialistic and threaten their liberties, it may be well that there is a League of Nations to champion the cause of the weak against the strong.

In conclusion, therefore, it is obvious that American citizens should clearly grasp the inner significance of the Monroe Doctrine and its related policy—Pan-Americanism. They should also see and appreciate the present reasons for a special policy in the Caribbean, realizing, however, that in a sense it is transient and may cease to have importance, if ever the time comes when the states of the Caribbean become self-respecting nations, fulfilling their obligations and following constructive policies.

As things are in world politics at the present time it is vitally important that the dream of American unity a hundred years ago should become the plan and policy of Pan-America. This hemisphere is a continent of republics, forming an American system to be held together by common interests and united wisdom; but it is also part of a world of conflicting interests, and in the discussion of these there should be a united front on the part of all the Americas.

It has been my experience that carelessness in dress and bearing are usually accompanied by loose performance of duty. Without doubt smartness has a direct influence upon the morale of an army. The lessons of the war in this regard seem to have been largely overlooked by all ranks. It goes without saying that if we are to hold the National Guard and the Reserves up to the highest standards it is very essential that both officers and men of the Regular Army should set a fine example, but this can be assured only through the most persistent efforts, both by example and precept, on the part of officers in high command.

—*General Pershing.*

The Infantry Division

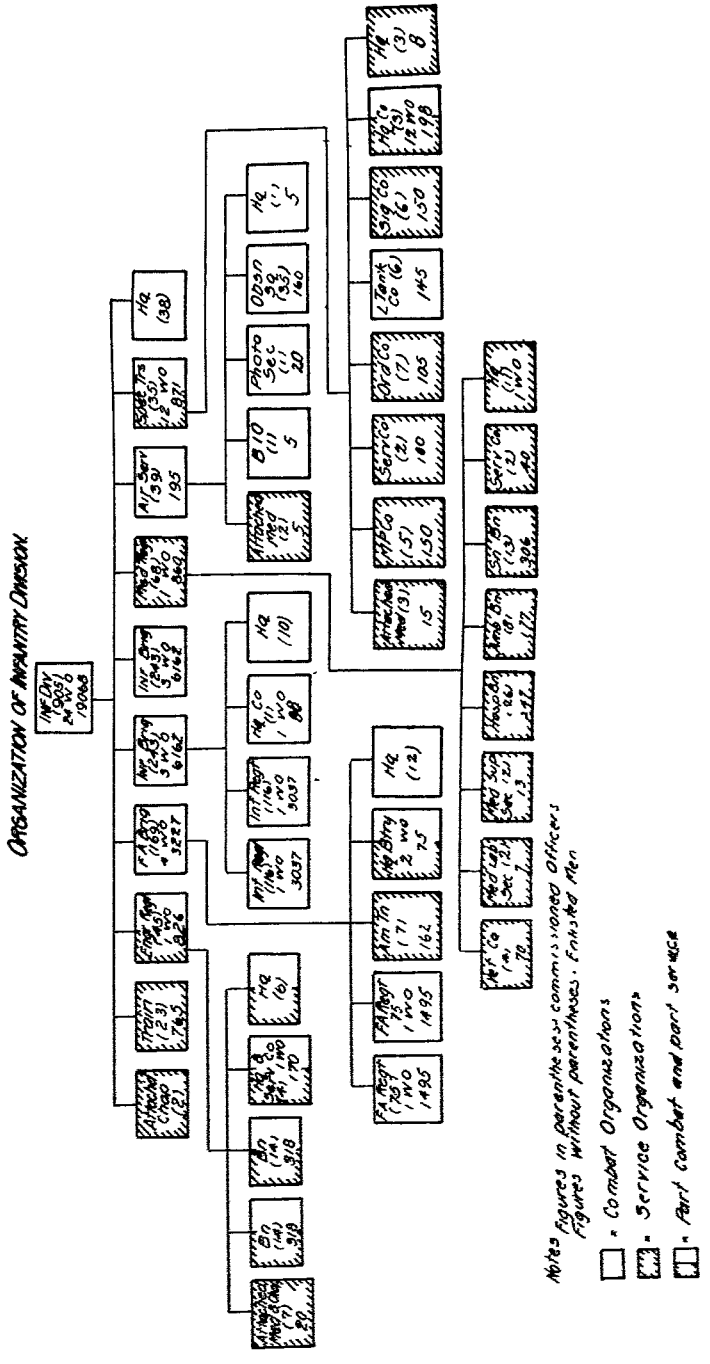
By Major C. F. McKinney, *Infantry*

THE following brief description of the organization, movement, deployment and supply of an infantry division is written for the benefit of those who have not had the opportunity to make a more detailed study of those points with the hope that it will help to make them more familiar with our basic large combat unit. Some knowledge of it is certainly necessary to all officers of every arm of the service.

The infantry division is the basic unit of organization and the basic large combat unit. It is the smallest body of troops whose normal organization provides for all arms, except cavalry. It is self-contained and self-sustaining and is capable of independent action.

Theoretically, the size and composition of the division is dictated by its prospective use against a first-class power in so-called open warfare; that is, in a warfare where the time spent in marching and maneuver is considerably greater than the time spent in actual conflict with the enemy. With such use in mind, the division may be defined as the largest body of troops composed of infantry, augmented by a suitable proportion of artillery and other essential auxiliary arms, that can meet the two following principal basic requirements. The first requirement is that it must be susceptible of being readily and efficiently controlled by one man. The second requirement is that when the division is in march column on one road, its combat elements must be able to close up on the head of the column for camp or billet in a day's march, while the field trains must be able to join their proper organizations at the end of the day's march; or the combat elements of the division, if in march column on a single road, must be able to deploy for action on the same day.

Naturally tactical considerations are important in arriving at the organization of any combat unit. Assuming a proper combat organization of each arm of the service, the division must be the grouping of combat units into an efficient combat organization composed of all arms. From a tactical viewpoint the infantry is the basic arm about which all other arms should be grouped. The other arms should be so combined with the infantry in such quantity, and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so harmonized with its tactical organization, that they will render it valuable assistance without impairing its efficiency.

Tactically the infantry brigade of two regiments is best suited to the use of our Army. So the division results from a consideration of the number of infantry brigades that can be efficiently employed under one command, and the addition of the necessary auxiliary arms. Military opinion varies as to the proper number of infantry brigades for a division. Some say there should be one (of three regiments), others, two and still others, three. This brings up the relative efficiency of the odd and even system of organization. These systems are generally known as the triangular and square systems, respectively. In general, the triangular system lends itself most readily to enveloping operations and the square system to penetrations.

From a tactical standpoint the functions of the division in an offensive are enveloping attacks (when acting independently) and penetrations.

It is considered that the usual operations of a division will be as a part of a larger force. Under such conditions little or no maneuvering is practicable for the division as a whole as it generally operates within a prescribed zone of action and its tactical function will be penetration. But within the division the infantry regiments and smaller units conduct operations by greatest possible use of maneuver such as local flanking operations. In addition the attack is based on a deep advance, in conjunction with adjacent divisions, which means that there must be continuity of attack, constant pressure being maintained by fresh impulses from the rear until the penetration is accomplished.

The above briefly stated general and tactical considerations, with those of mobility, maneuverability and facility of deployment, have brought about the present organization of the infantry division.

The War Department has adopted the square system, i.e., two infantry brigades of two regiments each as a basis for divisional organization. The infantry regiments, battalions and companies, however, are organized under the triangular system.

The infantry division comprises in its organization the essential combatant and administrative branches all in proper proportion and so organized as to make the division tactically and administratively a self-sustaining unit.

Its composition is shown in Fig. 1. Note that the field artillery brigade lends itself to the support of the infantry division of two

brigades, i.e., one regiment of artillery can support each infantry brigade which allows one battalion of artillery for the support of each infantry regiment.

The data given in this section is intended to emphasize to the reader the size of a division of twenty thousand men, in order to show the importance of properly considering questions of logistics, such as the time taken to deploy, the road spaces of marching troops, the difficulties of supply, etc.

The road space occupied by the infantry division in one column is approximately 28 miles, of which the troops and their combat trains may be taken as 18 miles and the field and service trains as 10 miles. When marching in the presence of the enemy, requiring an advance guard formation, more road space than 28 miles will be needed because of the formation and distances. For example, combat troops alone may require approximately 16 miles of road space, as follows:

Advance guard point and support, one infantry battalion, with platoon of howitzer company and appropriate distances	1.0 mile
Distance to reserve	.5 mile
Advance guard reserve, remainder of infantry regiment, one battalion of field artillery, one company of engineers, one ambulance company and one sanitary company	2.7 mile
Distance to main body	1.0 mile
Main body, rest of infantry, field artillery, engineers and tank company	10.8 mile
Total	16.0 miles

In rear of these combat troops, there will be about 4 miles of field trains, 6 miles of service trains and several miles of such service troops as the medical regiment, special troops, etc. Many elements of these service troops and trains, particularly the motor elements, may advance by bounds.

A consideration of the above indicates that from the tail of the combat troops in the main body to the place where they will be used in combat, a minimum distance of about 13 miles must be covered in deployment. This may be stated in approximate deploying times as follows:

Deployment using roads	5 hours
Deployment off roads	8 hours
Mean	6½ hours

Fig. 2 gives a diagrammatic illustration of a division in one column.

Division in Two Columns.—The division in advance guard formation in two columns may be taken as follows, for each column:

Advance guard point and support with distances to reserve	0.5 miles
Advance guard reserve with distance to main body	1.5 miles
Main body of combat troops only	6.0 miles
Total	8.0 miles

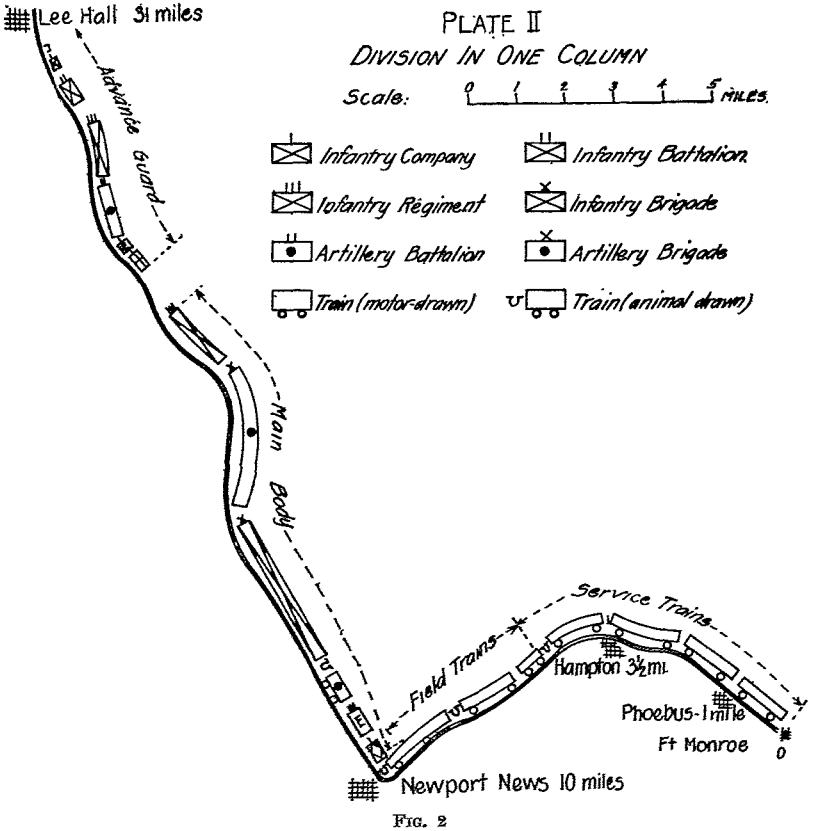


FIG. 2

In rear of these combat troops are field trains and the remainder of the division. The above gives a minimum deploying time for each column of approximately:

Deployment using roads	2½ hours
Deployment off roads	4 hours
Mean	3 hours

The rate of march of the division is necessarily that of its slowest element, the infantry. This rate on good roads is 2½ miles per hour, 12 miles being considered an average day's march for a division, although this can be increased with well seasoned troops.

In a rail movement the entire division may move by rail or certain elements may move by marching. Let us consider two cases: (1) The entire division moves by rail; (2) the foot troops and their field and combat trains move by rail and the remainder of division by marching.

In the first case 72 standard trains are required to move the division; and for a distance of 200 miles, assuming that 12 trains can be dispatched every 24 hours, it would take seven days to move the division after receipt of order for the movement.

In the second case 36 trains are required and a move of 75 miles would require four days, considering 12 trains are dispatched every 24 hours.

Under average conditions certain deductions may be drawn:

(1) For distances under 50 miles it is quicker to move entire divisions by marching.

(2) For distances from 50 to 90 miles it is quicker to move the foot troops and their field and combat trains only by rail, others by marching.

(3) For distances from 90 to 200 miles it is quicker to move the motor elements by marching and the remainder of division by rail.

Naturally the above comparisons are dependent on certain conditions and will vary according to the number of trains which can be dispatched per day.

On movement of a division by truck 1166 truck tons are required to move the personnel of the division when the horse and motor transportation units carry their own normal personnel.

It is considered inexpedient to use motor transport to effect troop movement: (1) For infantry, when distance is under 12 miles; (2) for artillery, when distance is under 36 miles.

Motor transportation will rarely replace railway transportation to adantage for movement of a division for distances in excess of 75 miles.

It is impossible, in this brief study, to discuss the division in combat but there are given two examples of the deployment of the division for combat, primarily to give an idea of frontages and depth. Fig. 3 gives this for the attack and Fig. 4 gives it for the defense.

It will be noted that the battalion is the basic small combat unit and that in any given situation the frontage and depth of deployment is governed by the number of infantry battalions in the front line. Also note that the frontage covered on the defense is much greater than in the attack for the same unit because the defense, in

being able to take advantage of terrain features and to better organize and control its fire power has certain advantages over the attacking force.

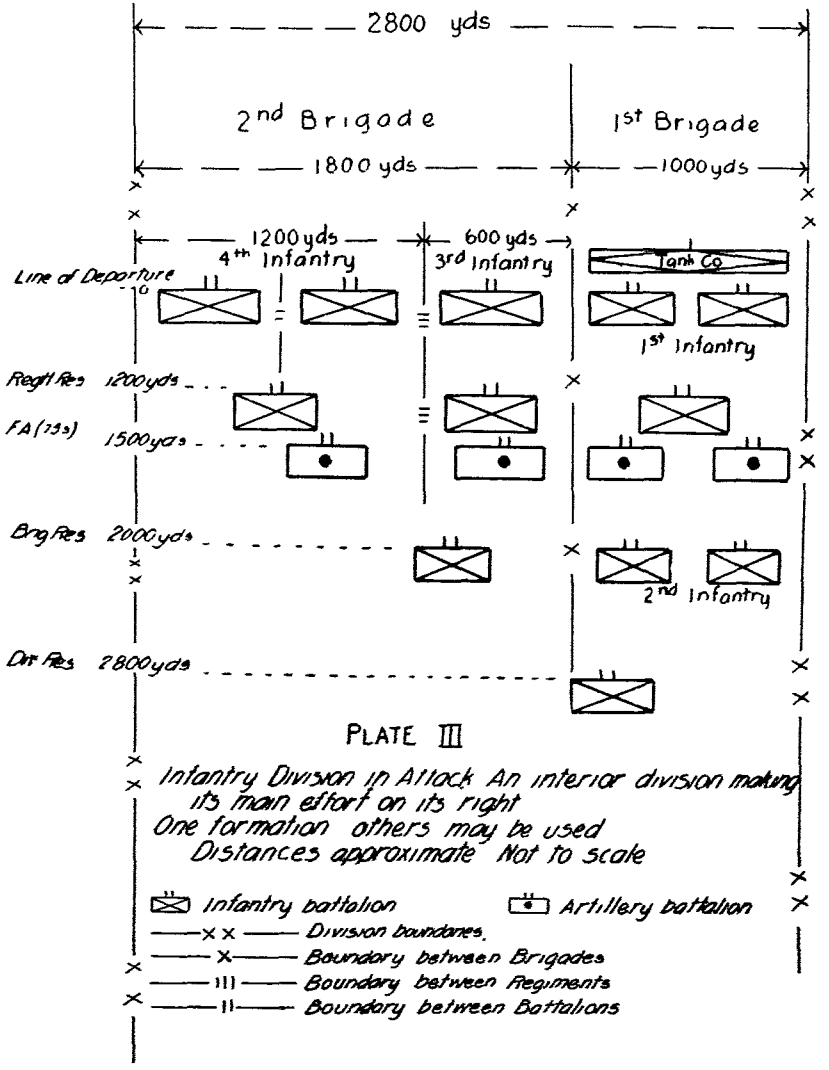


FIG. 3

Trains within a division are classified as follows: (1) Combat trains; (2) field trains; (3) service trains.

Combat trains are unit trains and consist of the rolling kitchens and water carts, and vehicles carrying ammunition and other material that may be required immediately for combat. They normally accompany their respective organizations.

Field trains are unit trains carrying in general rations, forage and baggage of organizations. They are generally grouped into marching columns and follow the combat troops of the division.

The Service Trains include the Division Train; the Artillery Brigade Ammunition Train; the Ordnance and Service Companies;

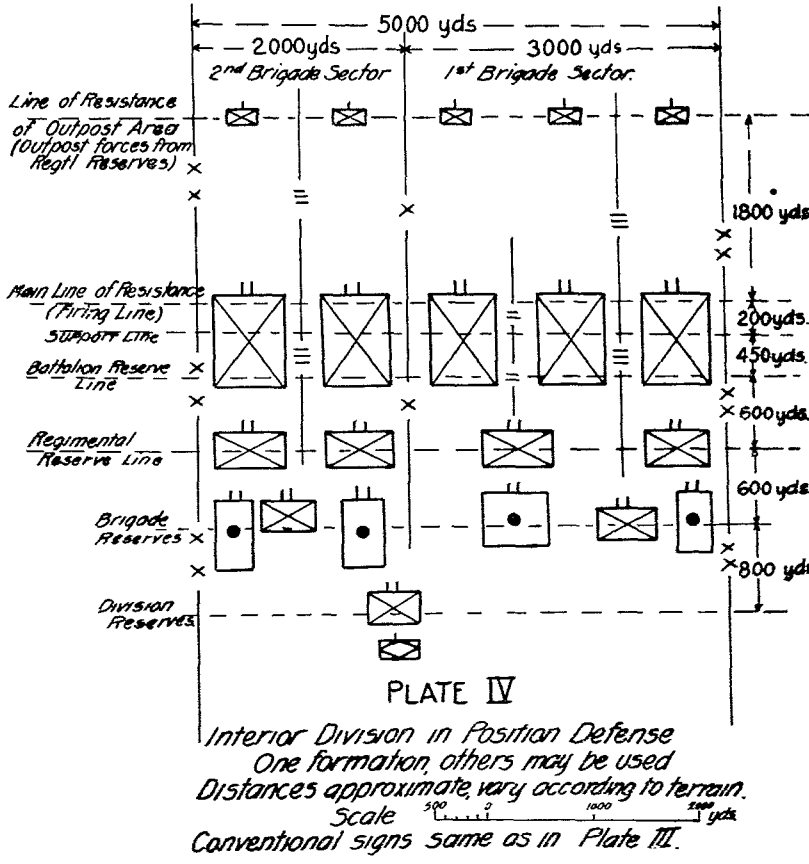


FIG. 4

certain vehicles of the Engineer Regiment; certain vehicles of the Medical Regiment; and vehicles of the Air Service.

Its functions are primarily supply and service for the combat organizations.

The following rations are carried in divisions:

On the man, 2 reserve rations; in rolling kitchen, 1 field ration; in field train, 1 reserve and 1 field ration; in division train, 1 field ration. Total, 6 rations (3 field and 3 reserve).

A railroad train arrives daily at the division railhead with Class I supplies (principally rations) for the division. The Division Train delivers these supplies to the distributing point for rations where they are turned over to the field trains of organizations. The field trains deliver the rations to the organizations.

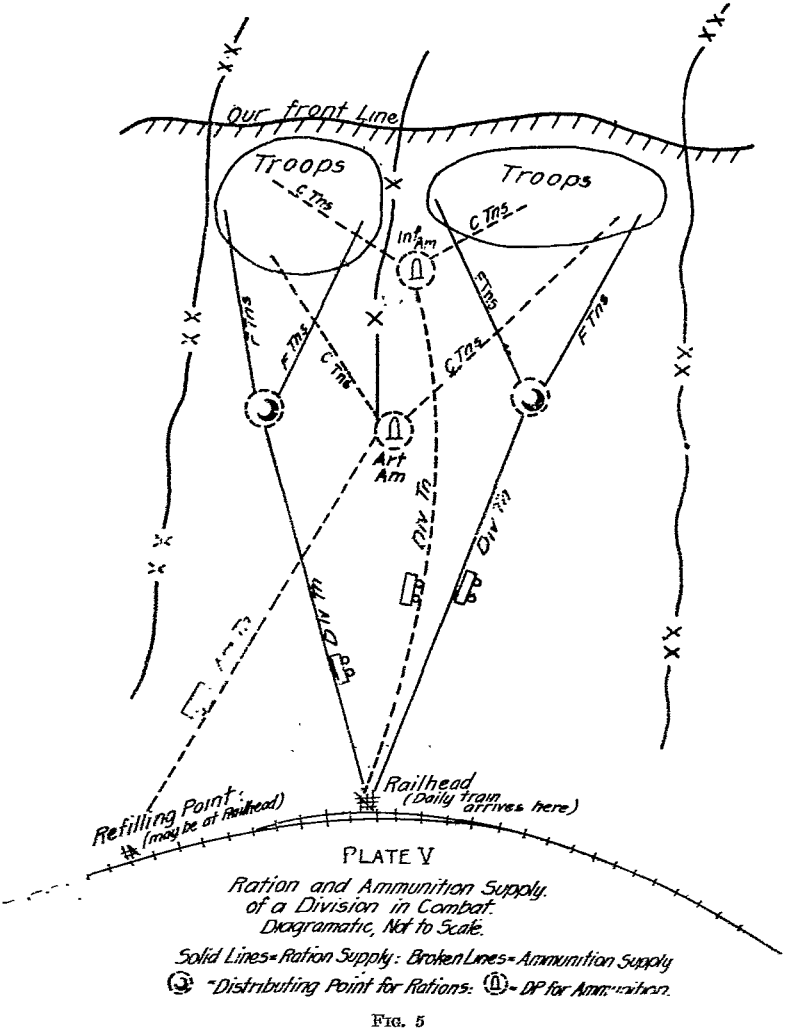


FIG. 5

For a rough diagram showing supply of rations and ammunition, see Fig. 5.

Roughly speaking, there is about 1½ days' fire of ammunition (for a division in serious combat) carried in the division. The infantry ammunition is carried on men, in carts, in combat trains,

and in the Division Train. The artillery ammunition is carried in the battery, in combat trains and in the F. A. Brigade Ammunition Train.

The necessity for replenishment of ammunition is not constant as in the case of rations and will vary according to the seriousness of the operations in which the division is engaged. Requisition is made for that needed and it is allotted and made available at refilling points established by the army or maybe forwarded to division railhead. In case of infantry ammunition, it is delivered by the division train to distributing points for ammunition where it is taken by combat trains of organizations and delivered to their respective units. Artillery ammunition is taken from the refilling point to the distributing points by the F. A. Brigade Ammunition Train and there turned over to the combat trains of organizations by which it is delivered to the organizations.

Free government has no greater menace than disrespect for authority and continual violation of law. It is the duty of a civilian not only to observe the law, but to let it be known that he is opposed to its violation.
—President Coolidge.

Notes on the Dardanelles Campaign of 1915

By MAJOR SHERMAN MILES, G. S.

EDITOR'S NOTE: *This is the second installment of Major Miles' Notes, the first installment having been published in the last issue of the* JOURNAL.

THE OUTSTANDING FEATURES OF THE TERRAIN

WE have seen that there were no Turkish defenses above Nagara Point. The mission of the Allied Army being to see the Fleet through the Strait, it follows that General Hamilton's objective was the control of the lower end of the Gallipoli Peninsula, the lesser peninsula, from Gaba Tepe-Kilia down to Cape Helles. Given that control, he would hold in his hands the batteries on the European side of the Strait, and he could silence the Asiatic batteries by observation from the European heights. The clearing of the mine-fields would then be a simple matter.

Now in this lesser peninsula there are four very marked and important topographical features. Beginning at the north, just above the Gaba Tepe-Kilia line, there are the heights of Sari Bair, with a long spur running out to Maltepe. The military value of these heights lies in the fact that a hostile force occupying them could cut practically all the Turkish lines of communication running into the lesser peninsula. The overland route down the peninsula would have been completely cut. The landings at Kilia and Maidos (one and one-half and two and three-fourths miles from Mal Tepe) could have been controlled by artillery fire. Even the last possible landing at Kilid Bahr (five and three-fourths miles from Mal Tepe) could have been rendered practically impossible if Allied troops had held Mal Tepe and the Allied Fleet had operated in the lower reaches of the Strait, below the mine-fields. Sari Bair therefore always offered the Allies the possibility of starving out the Turkish forces in the lesser peninsula, instead of defeating them on their own chosen ground.

The second topographical feature is the broad, flat valley running between Gaba Tepe and Kilia, across the waist of the peninsula. Streams in this valley drain into both the Aegean and the Dardanelles, the low water shed between them lying about one and one-half miles from the Aegean coast. The valley is dominated by Sari Bair to the north and by the Kilid Bahr plateau to the south of it.

Next we come to the Kilid Bahr Plateau, by far the most striking and important feature of the terrain. It was, in fact, the cita-

del of the Turkish defenses of the Dardanelles. It sweeps in a great horse-shoe, 10 miles in length, around the Jambax Dere, and at both ends falls away precipitously down to the waters of the Straits. It rises gradually up to its outer rim, as if made to conceal whatever might be on it, and then suddenly falls away to the plains north and west of it and to the Soghanlu Dere to the south. Looking down from it over the lowlands at the waist of the Peninsula, one is reminded of the view from Lookout Mountain, except that there are no woods in sight.

The great plateau sends out but two important spurs—a low one which connects it to the north with a steep and narrow ridge (the Kalkma Dagh) that abuts on the Strait between Kilia and Maidos, and a long swale which runs to the southwest, across the head of the Soghanlu Dere, and connects the Plateau with the high ground which centers at Achi Baba.

This brings us to the last of the outstanding topographical features of the lesser peninsula, Achi Baba and its adjoining heights. Except for the long open swale mentioned above, these heights have no connection with the Kilid Bahr Plateau. They run straight across the Peninsula on a line roughly W. N. W. by E. S. E., marked by the heights 472-709-518-488. They control the whole of the great slope which runs down to the toe of the Peninsula. Achi Baba (709 feet) is the dominant height, but the view from it of the Narrows and below is cut off by the Kilid Bahr Plateau and the spur 518. The heights centering at Achi Baba control neither the Narrows nor the citadel of the Kilid Bahr Plateau.

* * * *

In general, the broader valleys of the Peninsula were under cultivation at the time of the campaign. There were some trees, mostly olive, in the valley by Morto Bay and southeast of Gaba Tepe. For the rest, it was rocky ground covered only by low scrub. There were no swamps and the water courses were generally dry.

THE LANDING PLANS

The 8th of April saw General Hamilton clear of Alexandria Harbor, on his way back to the Dardanelles. His troops followed him during the next 10 days. He began to draw up his landing plan. What was his estimate of the situation at that time?

He says of his final talk with Lord Kitchener, on the 13th of March: "When I asked the crucial question—the enemy's strength —K. thought I had better be prepared for 40,000. How many guns? No one knew. Who was in command? Djavad Pasha, it is believed. But K. says I may take it that Kilid Bahr Plateau has been entrenched and is sufficiently held. South of Kilid Bahr to the point at Cape Helles, I may take it that the Peninsula is open to a landing on very easy terms. The cross fire of the Fleet lying part

in the Aegean and part in the mouth of the Straits must sweep that flat and open stretch of country so as to render it untenable by the enemy. Lord K. demonstrated this cross fire upon the map." Aside from some military handbooks, a faulty map and the outline of a *Greek* plan, this was all the information General Hamilton was given by the War Office. Military Intelligence helped him not at all. He does not even appear to have been informed of the existence of a British General Staff study on the Dardanelles of 1906.* Nothing shows more clearly the complete breakdown of the General Staff—no plans prepared and practically no information.†

On the 22nd of March General Hamilton notes in his diary: "My Intelligence folk fix the numbers of the enemy now at the Dardanelles as 40,000 on the Gallipoli Peninsula with a reserve of 30,000 behind Bulair; on the Asiatic side of the Straits there are at least a Division, but there *may* be several Divisions. The Admiral's information tallies and, so Birdie says, does that of the Army in Egypt. The War Office notion that the guns of the Fleet can sweep the enemy off the tongue of the Peninsula from Achi Baba southwards is moonshine."

General Hamilton counted on having an Allied "grand total of about 80,000—probably panning out at some 50,000 rifles in the firing line." The consolidated field returns gave an "effective strength" on the 25th of April of 2,840 officers and 72,646 men, with 150 guns.

The point to mark is that Hamilton estimated the enemy's strength as numerically equal, if not superior to his own—though, of course, not concentrated. He also had every reason to believe the Turks superior in artillery. The rugged nature of the terrain and the practical certainty that the enemy had used their months of warning to entrench their positions, added to the difficulties which the Allies knew they had to face.

Now, with this situation before him, how are we to explain General Hamilton's plan of campaign? For the plain fact is that he divided his forces and made his main effort on that very "tongue of the Peninsula" which he was satisfied the guns of the Fleet could not deny to the enemy.

There were two possible plans of campaign which did not involve a landing on the Peninsula. They can be disposed of in a few words. A march on Constantinople from a point near Enos, in Thrace, was out of the question for two reasons—the troops were there to help the Fleet pass the Dardanelles, not to play a lone hand, and their lack of land transport precluded any such overland campaign. A landing on the Asiatic side, to clear the southeast shore

*Note by General Hamilton: "I never heard of this until I had been back some months, when the whole of our troops had evacuated."

†Note by General Hamilton: "There were only a few dug-outs there. All the real G. S. were in France."

of the Dardanelles, was forbidden by specific instructions from Lord Kitchener, and should in any case have been ruled out because of the lack of land transport. "I had no transport, mechanical or horse, wheeled or pack, to enable me to support myself farther than five or six miles from the Fleet," writes General Hamilton.

General Liman von Sanders is reported to have said, in November, 1918, that, had he commanded the Allied forces, he would have landed on the Asiatic shore, opposite Tenedos. He does not make this statement in his recent book; but he does say that the Asiatic side "offered the enemy real chances of success," that the roads there were "fairly good," and that "it was the most vulnerable side of the fortress." General Birdwood looked with favor on the Asiatic side when landing places were being discussed early in April. Later in the campaign the "Asiatic plan" obtained strong French backing. It still has its advocates (see, for example, Major J. J. Bain's conclusions in his War College paper published in the COAST ARTILLERY JOURNAL of June, 1923).

To one who has gone over the ground from Chanak to Kum Kale, the advantages of this plan are not apparent. The country which an Allied advance would have had to traverse is even more rugged and difficult than that of the Peninsula. The rocky ridges, higher than those of Gallipoli, run in general perpendicular to the line of advance. The route of march would have been considerably longer. Both Allied flanks would have been exposed, the left to artillery fire from the Peninsula and the right to attack by Turkish troops.

But let us get back to the Peninsula. There were three sectors on which the Allied attack might fall—Bulair, Suvla-Gaba Tepe and Helles.

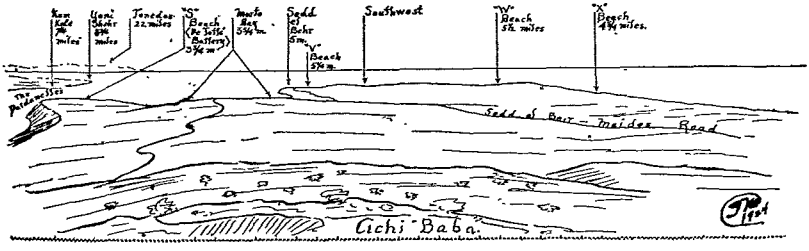
On the 18th of March, the day after his arrival, General Hamilton reconnoitered from the bridge of a fast cruiser the Gallipoli coast from Bulair clear around to Morto Bay. His diary entries, made on that day, are remarkable. The Turkish fortifications at Bulair impressed him very much: "In a word, if Bulair had been the only way open to me and I had no alternative but to take it or wash my hands of the whole business, I should have to go right about turn and cable my master he had sent me on a fool's errand."

Much has since been written on the Isthmus of Bulair as the neck through which the Turkish communications passed and the point which General Hamilton should have attacked. It may be noted that there were three cogent reasons which induced General Hamilton to dismiss Bulair from his plans. The first was the strength of the Turkish field fortifications there. The second, General Hunter-Weston's estimate, in which General Hamilton apparently concurred, that "the Turkish Army in the Peninsula is being supplied and reinforced from the Asiatic side and from the

Sea of Marmora, and is not dependent on the Isthmus of Bulair." The third reason was the strong opposition of the Navy, because of shoal water and its distance from the Mudros base. It may also be noted that General Birdwood, when he had considered the problem as the probable Commander-in-Chief a month before, rejected Bulair.*

Sailing south on his reconnaissance from the sea, General Hamilton continues: "Suvla Bay itself seems a fine harbor but too far north were the aim to combine the landing there together with an attack on the southern end of the Peninsula." (So Helles seems to have been uppermost in his mind from the first.) "Were we, on the other hand," he continues, "to try to work the whole force ashore from Suvla Bay, the country is too big; it is the broadest part of the Peninsula; also, we should be too far from its waist and from the Narrows we wish to dominate. Merely to hold our line of communi-

I Looking Southwest from Achi Baba
down over the plain towards the Sandings



cations we should need a couple of Divisions. All the coast between Suvla Bay and for a little way south of Gaba Tepe seems feasible for landing. I mean we could get ashore on a calm day if there was no enemy. Gaba Tepe itself would be ideal, but, alas, the Turks are not blind; it is a mass of trenches and wire. Further, it must be well under fire of guns from Kilid Bahr Plateau, and it is entirely commanded by the high ridge to the north of it. To land there would be to enter a defile without first crowning the heights."

Curiously enough he makes no notes in his diary on the stretch of coast, 11 miles long, from "a little way south of Gaba Tepe" to Cape Helles. Yet for a little over four miles south from Gaba Tepe, and again for over two miles directly opposite Achi Baba the land falls away to the sea in easy slopes and the beach is good. Infantry and mountain guns could have been landed anywhere along these reaches. A surprise landing on the first reach would have given direct access to the Kilid Bahr Plateau, two miles away, while the second reach lies but two and a half miles from the crest of Achi Baba. Nor does General Hamilton's diary bear any notes on the

*Note by General Hamilton: "Only one small landing place—from memory about 70 yards wide—in a rock-bound coast. We could only have worked on shore about a platoon at a time."

toe of the Peninsula—he becomes absorbed in the great naval attack going on that afternoon inside the Dardanelles.*

To what extent was his plan of campaign based on that "hurried scamper down the Aegean coast" (as he calls it)? To what extent was it influenced by Lord Kitchener's belief that the Fleet could sweep the flat and open country south of Achi Baba so as to render it untenable by the enemy—a belief which he had already found to be "moonshine"? It is difficult to say; but this much at least appears certain, that he had a strong inclination towards landing at Helles from the first, and that he practically decided on it as a result of what he saw and heard during his first few days at the Dardanelles.

On the 22nd of March, five days after his arrival and with the picture still in his mind's eye of the great battleships in action, he writes that Admiral de Robeck "is greatly relieved to hear that I have practically made up my mind to go for the south of the Peninsula and keep in closest touch with the Fleet." Then comes the period of reorganization in Egypt. While there he receives a cable from Lord Kitchener dated April 1st, suggesting "the advisability of effecting the main landing in the neighborhood of Cape Helles and Morto Bay, while making a feint in considerable force south of Gaba Tepe, with the possibility of landing and commanding the ground of Sari Bair, so that the enemy, on its southern slopes, may be prevented from supporting those on the Kilid Bahr Plateau. . . . I do not in the least wish to influence your judgment, formed locally, on the situation to be dealt with in the Gallipoli Peninsula, but only give you this for what it is worth. . . . When you have decided on your plans, I shall be glad to have a general idea of them." To this Hamilton replied, April 4th: "There is no need to send you my general idea, as you have already got it in one, even down to details."

*Note by General Hamilton: "The landing along the stretch four miles south of Gaba Tepe had been the scheme of the Greek General Staff, but that was before the Turks had made any preparations on Gallipoli and, actually, none of our sailors nor soldiers would look at it. We didn't know much, it is true; but we did guess the main strength of the Turks pretty accurately and we knew that would be found at Bulair, about Maidos and on the Kilid Bahr plateau; we had also specific information of big guns upon the last-named place. Our danger was a gale from the north. Both at Anzac and "Y" Beach this would have been dangerous, but along the four miles south of Gaba Tepe the full force would have fallen and it would have broken up our boats altogether. On the 23rd of April such a gale had blown! But apart from this an attack out of boats and up a glacis, like that of Gravelotte, against the commanding fortress of Kilid Bahr was too much to expect from human beings. We would not have thought of such a thing at Suvla had we not known that the Turks there were almost negligibly weak. Had we been able to get onto the dead ground at the foot of the Kilid Bahr bluff during the night? Yes—but to advance under that fire of artillery and musketry during daylight with Maidos and the Olive Grove guns outflanking us on our left and our boats being shot to pieces as they approached the shore—that simply was not in the picture. (N. B.—I had no mountain guns besides the two batteries of Indian popguns landed with Birdwood at Anzac.)

"As to the two miles directly opposite Achi Baba, I am very much inclined to agree, except with your remark that the beach is good. Certainly there is a strip of sand at the foot of the rough cliffs in fine weather, but I beg you ask one of your own American Navy men whether it is the sort of spot at which he would care to undertake to land 20.000 men and keep them supplied! All the same, I would think very seriously of landing a force there were I to throw the dice of war over again. 'Y' Beach was an analogous attempt, and if that failed I say it should not have failed. 'Y' Beach was my own personal idea and it nearly succeeded, as a landing opposite Achi Baba might have succeeded, because no preparation would have been made to guard against an operation which fell into the same category as that of Wolfe at Quebec. At the time, the objection of splitting up my force would have been urged by my own General Staff—at least I think so. All the same, on the whole I agree with you here."

On the 9th of April, returning to the Dardanelles, he makes long entries in his diary in which he summarizes the estimates of the military situation drawn up by his generals—Birdwood, Hunter-Weston and Paris.

General Birdwood "rather inclines towards a landing on the Asiatic side." He also "seems to think we might dominate the Peninsula from the country around Chunuk." He is not for a landing at Helles (although a month earlier he had proposed it). General Hunter-Weston advises the abandonment of the campaign, or at least its postponement. "There is not in present circumstances," he writes, "a reasonable chance of success." If a landing must be made, he thinks the only landing places "worth serious consideration" are those near Suvla and Helles, and of these two he prefers Helles because "the Fleet can also surround this end of the Peninsula and bring a concentrated fire on any Turks holding it. We therefore should be able to make sure of securing the Achi Baba position." General Paris, still more pessimistic, sees 250,000 Turks within striking distance. "To land would be difficult enough if surprise were possible, but hazardous in the extreme under present conditions." If a landing be made, he also prefers Helles because it "is the only place where transports can come in close and where the actual landing may be unopposed."

No one apparently suggested landing on a broad front between Gaba Tepe and Helles. Yet this would appear to have been perfectly feasible, and troops landed there could have been supplied without more difficulty than those which were actually landed at Anzac. Had the landings been echeloned in point of time and made left in front the limited boat space could have been utilized at one beach after another, and Turkish reserves arriving from the north might have been held up—Kilid Bahr itself might have been taken by a *coup de main.*

But to get back to estimates of the situation submitted by the British Generals: Hamilton notes their salient points in his diary. But he comments only on the suggestions of landings near Enos and on the Asiatic side—he will have none of them. "I am still for taking the shortest, most direct route to my objective, the Narrows."

Then comes his decision, announced on the 10th of April, 15 days before the landing. In brief, it was to make his principal effort at Helles, with the 29th Division and three battalions of the Royal Naval Division, supported later by the rest of the Royal Naval and the French Divisions; to land the Anzac Corps north of Gaba Tepe ("a strong feint which may, and we hope will develop into the real thing"); to feint at Bulair, Kum Kale and Besika Bay. The objective of the Helles force was Achi Baba, and of the Anzac force Mal Tepe.

This was the vital decision of the campaign—the decision which led to consequences fatal to the Allies. When, many months later, the decision was reversed and the main axis of attack swung far to the north, the best chances of success had already been lost.

* * * *

All the discussions which have since been written on the pro's and con's of various possible plans, and especially on the landing at Helles, are beside the mark. They present the academic point of view not that of the Commander-in-Chief at the time he made his decision. For this reason, General Hamilton's diary warrants the closest examination, since the essential lesson lies in the answer to the question, "Why was this decision made?" And on this crucial point General Hamilton's narrative, so brilliant and usually so clear, is not explicit.

"From the south, Achi Baba mountain is our first point of attack," runs the diary. " . . . At the same time, also, the A. and N. Z. Corps will land between Gaba Tepe and Fisherman's Hut (just north of Ari Burnu) to try and seize the high backbone of the Peninsula and cut the line of retreat of the enemy on the Kilid Bahr plateau. . . . The first and foremost step towards a victorious landing was to upset the equilibrium of Liman von Sanders. . . . I must try to move so that he should be unable to concentrate either his mind or his men against us. . . . I would like to land my whole force in one—like a hammer stroke—with the fullest violence of its massed effect—as close as I can to my objective, the Kilid Bahr plateau. But, apart from lack of small craft, the thing cannot be done; the beach space is so cramped that the men and their stores could not be put ashore."

Now, the upsetting of General Liman's equilibrium, desirable as it might have been, could only have been a temporary measure, an affair of 48 hours at most. It is difficult to believe that it was the paramount consideration in General Hamilton's mind. And what did he mean by "a victorious landing"? Did he choose his landing places with a view to final victory, the defeat of the Turkish 5th Army and the control of the Straits, or simply with a view to a successful *landing* of his forces?

His diary and despatches give the impression that the landing per se, and not the landing considered as the first approach to his final objective, was uppermost in his mind.* This is the meaning of

*Note by General Hamilton: "Certainly it was so. In my mind the crux was to get my army ashore, a feat declared by von der Goltz and many others to be impossible. *Once ashore, I could hardly think Great Britain and France would not in the long run* defeat Turkey, as of course they could have had they put their backs into it. There were troops enough in Egypt alone to carry my attack through at that moment had I been able to call them up.

"Please bear in mind this point carefully: On the 24th of April, 1915, the problem as it presented itself to us was *how to get ashore!* The dangers and difficulties alive before our eyes then were: (1) how to avoid being slaughtered in our boats and on the beaches; (2) how to get food, drink and munitions as we went on. The opposition of the Turkish Army, good as the Turkish soldier might be, would not then have availed anything against England, but, unfortunately, we had forgotten to reckon with the much more deadly opposition offered by the French General Staff, supported by British Generals in France!"

the reference to Liman von Sanders' equilibrium. "Our first step of landing under fire will be the most critical as well as the most vital of the whole operations," he wrote Lord Kitchener on the 22nd of March. He was tremendously impressed by the "operation of landing in the face of an enemy—the most complicated and difficult in war." And well he might have been. But nevertheless the landing could only be the first objective; and there seems not to have been sufficient thought given to the consideration of the landing beaches as gateways to the final objective—the domination of the Peninsula and the Straits.

It was the irony of fate that General Hamilton should have encountered the greatest resistance and suffered the greatest losses at the very beach which was "supposed to be the softest landing of the lot" and which was farthest away from his final objective.*

* * * *

Why did General Hamilton choose Helles for his main effort? At Helles the terrain was all against the Allies. Not only did Achi Baba command the entire toe of the Peninsula right down to the cliffs above the beaches—an open, gently sloping plain almost devoid of cover—but the Turks had also the advantage of the security afforded by the Saghir and Soghanlu Deres. The Saghir Dere reminds one strongly of a deep Texan arroyo. The Soghanlu Dere, three miles to the northeast of Achi Baba, is a still deeper and much broader valley, the sides of which are not so precipitous. Both afforded excellent shelter for the Turkish reserves, dumps, etc., while those of the Allies lay under the fire of the enemy. Even had Achi Baba been taken, the terrain would still have been against the Allies. Achi Baba dominates to the southwest; but to the northeast the country is quite different. Surrounding the Jambax Dere lies a great semi-circular plateau, commonly called Kilid Bahr, its northern end resting on and commanding the Narrows. It is nowhere quite so high as Achi Baba, from which it is separated by the deep valley of the Soghanlu Dere. But the capture of Achi Baba would have been of little advantage to the Allies in a subsequent attack on the plateau of Kilid Bahr.

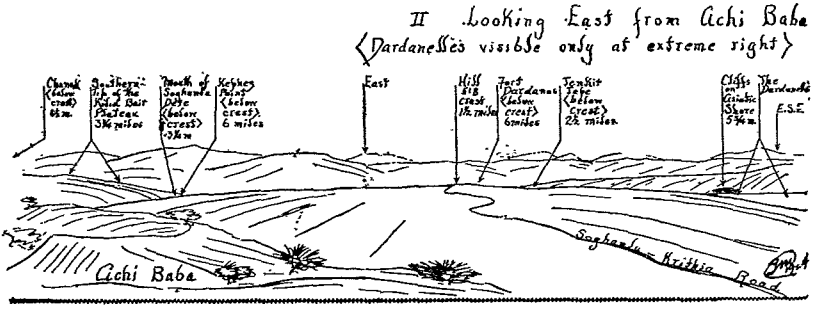
In favor of the Helles landings, General Hamilton thought that he could not be opposed there by more than one-tenth of the Turkish Army and that "with the exception of Helles, they (the landing beaches) were all commanded by elaborate net-works of trenches." General Paris suggested that a landing at Helles might be unopposed. Again the predominant idea seems to have been of the landing, and not of the final objective beyond the landing beaches.

Still more, apparently, did the idea of keeping "in closest touch with the Fleet" influence General Hamilton's decision to land at

*Note by General Hamilton: "You see the Turks had the same view of the problem as ourselves, on this one *tactical* point."

Helles. There were of course two sides to this. The first was the assistance the Fleet could give the Army. Of Helles, General Hamilton later wrote: "Always I could count on the close cooperation of the Fleet; here my flanks rest upon a friendly element, even if all the armies of the Sultan converge upon my modest force." The hope of sweeping the enemy off the toe of the Peninsula by naval gun fire had been abandoned; but still battleships on both flanks of the Army might count for something. Not until later did Hamilton realize that the terrain from Achi Baba south is slightly concave, "hollowed out like a spoon, presenting only its outer edges to direct fire from the sea."

The other side of the question of cooperation with the Fleet was the direct aid which the Army might render in getting ships past the Narrows. The Official Naval History says that "it appears to have



been fully recognized that the key to effective cooperation between the ships and the troops was the capture of Achi Baba as an observation point." And Winston Churchill writes that: "The possession of the vital observation point of Achi Baba would have enabled the indirect naval fire to be directed with the utmost accuracy upon the forts at the Narrows." As a matter of fact, the latter statement is only partially true. Achi Baba itself is a poor observation point to the east. Had Hill 518 also been taken, fair observation would have been had on the Asiatic batteries from Kum Kale to Kephez Point. But the Chanak group of batteries and all of those on the Gallipoli shore could not have been seen even from Hill 518. It is only when the little knoll of Tenkin Tepe is reached, two and one-half miles beyond Achi Baba and a mile beyond Hill 518, that these batteries come out from under the cover of the Kilid Bahr Plateau.

Nevertheless, the Navy's strong desire for the possession of Achi Baba influenced General Hamilton to a large extent. Although Admiral de Robeck had called for assistance from the Army, he had given no intimation that he would not cooperate by renewed naval attacks. On the contrary General Hamilton knew that there was a strong inclination in the Fleet to resume naval operations, and in early April he had no reason to believe that they would not be re-

sumed. When he left for Egypt, Commodore Keyes had cheered him with the hope of getting "his Fleet Sweeps so reorganized as to do away with the danger of mines by the 3rd or 4th of April; then, he says, with us to do the spotting for the naval guns, the battleships can smother the Forts and will alarm the Turkish Infantry as to that tenderest part of an Army—its rear." "Spotting for the naval guns" pointed, of course, to the capture of Achi Baba.

That the Navy wanted Hamilton to land at Helles, and that they thought that line of attack would best contribute to combined operations is beyond question. Hamilton's mission was to see the Fleet through, and naturally he wanted to land when he could best cooperate with a naval attack. But the Navy never again attacked. To that extent they let him down.

The reason given by General Hamilton for the division of his forces—lack of small craft and beach space—is another indication that Helles was uppermost in his mind. For he could not increase his small craft by dividing his forces, and he need not have divided them for lack of beach space at Anzac. His reconnaissance from the sea on March 18th must have shown him that there was more than enough beach space between Suvla and Gaba Tepe for all his forces, and certainly far more than at Helles. But his inclination was all towards Helles, and there the beaches were cramped; there was not enough space to land the whole Army. He enlarges on this point in his subsequent despatch describing the landing:—"The beaches were either so well defended by works and guns or else so restricted by nature that it did not seem possible, even by two or three simultaneous landings, to pass the troops ashore quickly enough to maintain themselves against the rapid concentration and counter attack which the enemy was bound in such case to attempt." Hence "landings at as many points as possible," even if it meant splitting his army in half.

So it comes down to this: Helles was chosen for the main effort primarily in order to "keep in closest touch with the Fleet" in combined attack, and secondarily because landings there might not be vigorously opposed. Hamilton's dominant idea, aside from close cooperation with the Fleet, was to get his troops ashore.* The landing he feared—what followed could be dealt with later. The division of his forces resulted from his theory that dispersion was necessary to insure landing against the least possible opposition.

Yet these explanations do not altogether explain. There was something behind the Helles landing and the division of the forces—the two great mistakes—that is not covered by the presence of the Fleet or the lay of the land. One is forced back to a more simple theory—that General Hamilton greatly underestimated his enemy. I know that against this theory chapter and verse may be quoted. On March 18th, for instance, Hamilton wrote Kitchener—"If it

*Note by General Hamilton: "Correct."

eventually becomes necessary to take Gallipoli Peninsula by military force, we shall have to proceed bit by bit," and on March 22nd his diary notes—"Have cabled home begging for more engineers, a lot of hand grenades, trench mortars, periscopes and tools."* This certainly does not look like the expectations of an easy victory.

On the other hand, General Liman bluntly says that it was a case of underestimating the Turks and Admiral Wemyss says that "things were underestimated." General Callwell speaks of it as "an untoward misunderstanding." Winston Churchill writes that: "No one estimated truly the tremendous strength of the Turkish resistance against the Army," and that "5000 casualties . . . was the War Office estimate of the cost of the landing and of a successful and decisive operation." The Australian Official History says that: "The main reason for the failure of the plans, both at Helles and Anzac, was the enormous extent of the objectives which were set for the covering force, and the contempt in which the Turkish Army was held by those who made the plans." The final report of the Dardanelles Commission states that: "At the outset all decisions were taken and all provisions based on the assumption that, if a landing were effected, the resistance would be slight and the advance rapid."† General Hamilton himself seems to acknowledge an underestimation of the enemy when he writes, two months after the landing: "The one fallacy which crept into your (sic) plans was a non-recognition of the pride and military morale of the Turk. There was never any question of the Turk being demoralized or even flustered by . . . troops landing in the rear."‡

Furthermore, nothing but an underestimate of the enemy really explains the facts. An able commander deliberately divides his Army in the face of an enemy whose forces, though necessarily dispersed over a 60-mile front, probably equal his own in rifles and are superior in guns. He gives his enemy interior lines.§ He launches his main attack straight up that long glacis which ends with the double ramparts of Achi Baba. When he makes this decision he already knows much of the lay of the land—he has sailed around it

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*Note by General Hamilton: "Had they only been sent!"

†Note by General Hamilton: "I can't accept that. There may have been that *hope;* hardly an assumption."

‡Note by General Hamilton: "If my memory serves me right, this was with reference to a remark by Lord Kitchener that if one submarine got through and waved a flag in the Marmora the whole of the Turks on the Peninsula would skedaddle."

§(Note: In fairness it must be said that General Hamilton did not think the division of forces would give the Turks interior lines. "With our sea power," he wrote, "we can shift a couple of brigades from Gaba Tepe to Helles or vice versa quicker than the Turks can march from the one theater to the other." Aside from the fact that the Allies enjoyed undisputed sea power for less than a month after the landing, this assumption of General Hamilton's is open to serious doubt. The overland road distance was about 11 miles—say four marching hours. The embarking and debarking at Anzac and at Helles had to be made in small boats, under fire. At both places the transports had to lie well off shore to avoid the enemy's shells. The steaming distance was at least 15 nautical miles. It does not seem possible that a force of anything like "a couple of brigades" could have been embarked, transported and debarked inside of four hours. As a matter of fact, on the night of May 5th-6th (in fairly rough weather, it is true) five hours were spent in embarking two brigades at Anzac.)

and studied it through powerful glasses. He has seen that Achi Baba dominates the whole of the toe of the Peninsula except the beaches under the cliffs. He cannot get away from the sight of that rolling height. And it is plain that from that crest straight down the field of fire must be almost perfect—hardly a tree or a shrub offers concealment to a man creeping forward, hardly a dead space exists.

But that great glacis offers an ideal battlefield to one who feels sure that he has but to come to grips with his enemy in order to beat him. The beaches behind it are at least partially sheltered; the troops can get ashore; before them lies a great plain rising on the average but a hundred feet to the mile; their flanks cannot be turned; on the contrary, naval fire will give some support on at least one flank—an ideal field of battle if the enemy has not much stomach for the fight.

The landing of the Anzac Corps, 13 miles to the north, fits into the picture admirably. It may well "develop into the real thing," the force thrown clear around the enemy to smash into his retreat and turn it into disaster.

In spite of much evidence to the contrary, of the pessimistic estimates of his chief subordinates and some of General Hamilton's own words before the campaign began, the impression one gets on the battlefield at Helles prevails—it was the Turks of Kirk Kilisse and of Lule Burgas, and not the Turks of Plevna whom Hamilton expected to meet at Gallipoli.

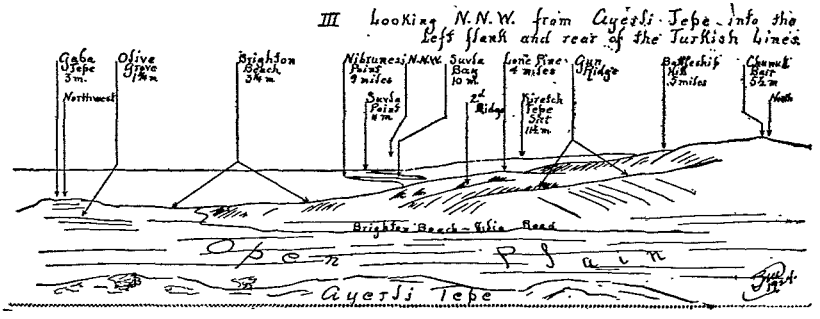
And indeed there was then little reason to rate the Turks as first-class fighting men. Nearly 40 years had elapsed since the days of Osman Pasha, and not yet three since a Bulgarian army had swept through Thrace with but feeble opposition. In the Great War itself the Turks had already been badly beaten by the Russians in the Caucasus and by the British on the banks of the Suez Canal. It was a natural error to make, that of underestimating the Ottoman fighting power; but it was one rarely equalled in disastrous consequences.

I add to this long discussion of the landing plans but one comment from the opposing side. A Turkish General Staff report says: "After a serious demonstration at Helles, a landing (of the whole force) between Gaba Tepe and Suvla would probably have been more successful; at any rate it is worthy of consideration. A successful landing there, on the waist of the Peninsula, would have meant the speedy capture of the vital area."*

*Note by General Hamilton: "To this there was one absolutely vital objection. There was not enough water to keep the Army alive. Take the base of about 3000 yards which is the chord of the arc formed by the Anzac trenches between 25th April and 8th August. There was only a little brackish water in wells dug by ourselves which quickly became exhausted. I could not have watered another brigade from that base. If Gaba Tepe and Suvla Bay are included, there would have been water for the flanks—but what a wide extension of front! Further, there was no room on the narrow strip of sand between hills and sea on the actual Anzac beach to stock the reserves of food and munitions necessary in case a storm cut off communications for a week. No; it was too difficult!"

THE NAVAL SUPPORT OF THE LANDING

The entire operation of landing at Helles and Anzac was handled by the Allied Fleet. Considering their imperfect equipment in small craft and the difficulties of getting the right troops on the right beaches at the right time in spite of strong currents, of providing proper covering fire, etc., etc., it was a notable feat. As General Hamilton says: "Staff Officers who have only had to do with land operations would be surprised, I am sure, at the amount of organized thinking and improvisation demanded by a landing operation. . . . The diagrams of the ships and transports; the lists of tows; the action of destroyers; tugs; lighters, signal arrangements for combined operations; these are unfamiliar subjects, and need very careful fitting in."

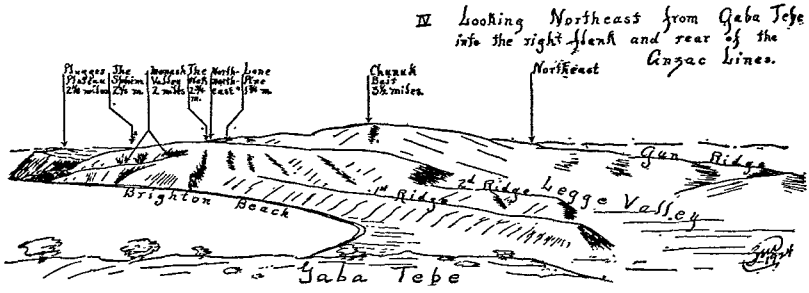


One serious error was made. The Anzac Corps was to have been landed on a 1600-yard front, the right 800 yards north of Gaba Tepe. It was actually landed on a very narrow front, the center being about 4400 yards north of that promontory. Some have claimed that this was fortunate for the British because of the guns near Gaba Tepe. But it was not according to plan. Instead of landing at least the right flank before a low stretch of ground affording easy access into the interior, where the guns of the Fleet might have helped them, the entire force came straight up against the most rugged and difficult escarpment of Sari Bair. They were landed in the dark at the very point where the beach was most cramped by jutting cliffs and which General Birdwood had previously described as "so very difficult and broken that it is impossible to attempt a landing there while it is dark."

The ships had sailed from Mudros on the evening of April 24th. Between midnight and 1:00 a. m. of the 25th they reached the *Triumph*, which the Official Naval History says "had been sent on overnight, with orders to anchor quietly at the exact rendezvous five miles west of Gaba Tepe." The troops were then transferred to small craft. The moon set at 2:30 a. m. By 3:00 a. m., it was very dark, and at 3:30 a. m., the order to advance was given. The boats

approached the shore at a speed of five knots, and were swept to the northward by a current which they did not know existed.

It is not clear whether the *Triumph* took up her position by daylight, and hence it is not certain that she was accurately placed. Nor is it apparent that, from the rendezvous fixed by the *Triumph*, the British had any means, other than small boat compasses, of steering accurately towards the appointed beaches. In approaching the shore the first boats formed a line of 12 tows. The right flank tow was to be the guide. So dark was the night that the third tow from the right failed to see the guide and swung to the left. The senior officer was in the left flank tow. The junior officer who should have guided also swung to the left, conforming to what he supposed to be the movement of his senior.



Even if the *Triumph* had been accurately placed, a current of a knot an hour, to say nothing of the mistake about the guide, would have carried the boats well off their course before they reached the beach about 4:30 a. m. Under these circumstances it is perhaps remarkable that they should have missed their intended landing by less than two miles. To naval officers approaching a long coast on a dark night one beach may have seemed about as good as another. But an error of more than a mile and a half in the position of an army corps on the field of battle is generally serious, especially when that corps finds before it a very difficult and altogether unexpected kind of terrain. The resulting confusion destroyed completely its carefully prepared plan.

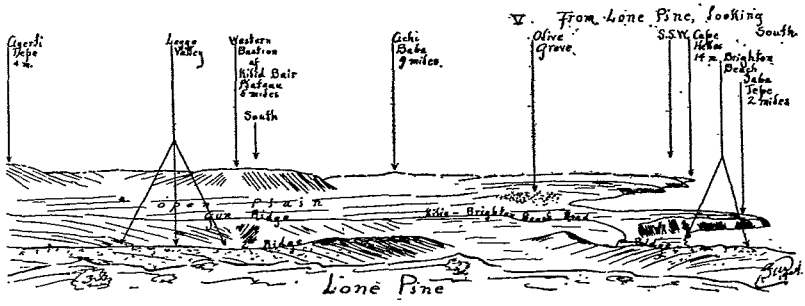
Furthermore, landing on a front of only a few hundred yards instead of on one of nearly a mile made a very great difference. A Turkish General Staff report suggests that, had the Anzac Corps landed on a broader front (as was planned), it would have outflanked the Turkish troops and "gained its objectives with more certainty and speed."

There appears to have been a lack of understanding between the Army and Navy here. Had the Navy been sufficiently impressed with the importance of landing the troops exactly according to plan, had the Army made clear the necessity, it seems probable that some

method other than that used could have been found. Submarines, for instance, might have located themselves by daylight observations through their periscopes. Having done so, they could have laid on the bottom until the appointed hour when their lights, showing only to seaward, could have fixed a line to guide the approaching flotilla. Or other methods, such as the use of buoys, might have been devised had the naval authorities realized that the entire plan hinged on an accurate landing.*

* * * *

This brings up the whole question of night versus day landings. General Hamilton wanted to make his landings just before dawn. The naval authorities opposed this strongly, largely because of the difficulty of making the beaches by night. The result was a compromise—a landing before dawn at Anzac, a daylight landing, preceded by a naval bombardment, at Helles.



It cannot be said that these two experiments proved anything except the great disadvantages incident to both day and night landings. At Helles General Hamilton's most poignant fear was realized. His troops came under a severe fire before they were well ashore. Their losses were very heavy, and at one point (V Beach) they were held at the water's edge until nightfall. But on the other hand, the experience at Anzac more than sustained the naval opposition to landing by night. The fundamental mistakes made in approaching the coast in the dark were irreparable.†

* * * *

A more discussed point in the cooperation of the Navy was the supposed failure of its fire against land targets. The Army was disappointed in the effect of naval shells, and to a certain extent the Fleet, also, was surprised at its inability to keep down the Turkish fire at some critical moments.

The outstanding example was V Beach. The rising ground behind it forms an amphitheater, about 500 yards wide and 500 in depth. It does not seem possible that anything could have lived in

*Note by General Hamilton: "Remember, annihilation would have been the penalty had the Turks got wind of the landing place beforehand."

†Note by General Hamilton: "The currents ran much faster at Helles than at Anzac."

that confined space under the fire of a battleship. Yet *Queen Elizabeth, Cornwallis* and *Albion* "and other ships" battered it at intervals for a full 24 hours. At least eight 15-inch, eight 12-inch and a score of 6-inch guns had their fling at that most obvious target at close range—and still the Turkish rifle and machine gun fire broke out whenever the big guns laid off.

But we must remember two things: First, that the landscape, even at Y Beach, is fairly large, and there were very few Turks in it to be hit; second, that troops in the field sustain relatively slight losses from armor-piercing shells. Even the British "common shell" were ineffective against land targets. What they needed (and did not have) were high capacity shells with instantaneous fuses.* In the soft limestone and clay of the Peninsula, the British shells either went in a long way and broke into few pieces on explosion, or else, particularly at short range, they ricocheted over the crest and disappeared into the blue.

Furthermore, the targets differed entirely from anything the Navy had experienced. The low site of the guns and their flat trajectory also counted against them. As Admiral de Robeck said in his telegram of May 10th—"When it is a question of trenches and machine guns the Navy is of small assistance; it is these latter which have checked the Army."

In moral effect, there seems to be no doubt that the naval fire weighed in the scale. All Turkish accounts speak of the terrific bombardment and of the difficulty in getting their men sufficiently accustomed to this sort of fire to enable them to hold on. The material damage may have been slight in comparison to the weight of metal thrown, General Hamilton may have thought that "before they will be much good at landmarks the sailors will have to take lessons in the art," but the Turks had little stomach for the Navy shells, particularly at first.

Still less did they like the enormous shrapnel by the 15-inch guns of the *Queen Elizabeth*. The Official Naval History and General Hamilton's diary both speak of a single 15-inch shrapnel wiping out a Turkish company near Y Beach on April 28th. The moral effect of this fire on the hard-pressed British troops was certainly good. And it can well be imagined that those huge projectiles, bursting in air and shooting out great sprays of lead, 13,000 bullets a throw, considerably disheartened the Turks."†

In covering the landing of the troops, the Navy put some fine feats to its credit. The bombardment of the Turkish battery on Gaba Tepe on the morning of April 25th was an excellent bit of work. The cruiser *Bacchante* was ordered to silence that trouble-

*Note by General Hamilton: "I said so over and over again; but the sailors, afraid of Lord Fisher, dared not press for any of these extras. I myself could not write to the Admiralty because of War Office jealousy. Had the demands been able to reach Churchill all would have been well, but that was just the hitch."

†Note by General Hamilton: "There were, I think, only 25 of them altogether."

some battery, and, in order to get her guns to bear on the reverse slope of the promontory, her captain brought her slowly onto the beach until her stem touched ground. Then he opened fire, with good effect.

At X Beach the battleship *Implacable* covered the landing. She came in until her anchor, hanging outboard, dragged in six fathoms of water. She then let go close on the five fathom line about 450 yards from the shore. All of her broadside guns opened on the Turkish trench on the crest of the 40-foot cliff above the beach. There are indications, even today, that she literally blew off the top of the cliff. At any rate her fire kept the Turks down, and the landing was made without appreciable loss.

There were many other incidents of effective support rendered by the Navy. The battleship *Goliath* and the cruisers *Dublin, Amethyst* and *Sapphire* greatly aided the battalions landed at Y Beach. Later the fire of the cruisers *Dublin* and *Talbot* made possible the recapture of that same position by a battalion of Gurkhas. On the 27th of April *Queen Elizabeth,* firing over the Peninsula at a range of about 12,000 yards and with kite-balloon spotting, sank with her third shot a large Turkish transport and forced the enemy to use Akbach instead of Maidos as a debarkation point for troops from Asia and Constantinople. There appears to have been but one kite-balloon in the Fleet. Much more effective work could have been done by the naval gunners had a greater number of these balloons been available.

A point to note, in connection with the naval fire, is that artillery officers of the Army were assigned to some of the ships as assistants in directing the fire, and with "excellent results," according to naval accounts.

* * * *

The success of the *River Clyde* must also be credited to the Navy. The idea of using that harmless-looking old collier to run 2000 troops straight onto the beach apparently originated in the Fleet, and the ship was commanded by a naval officer. Although the pontoon bridge which was to have connected her with the beach was promptly carried away by the current and the Turkish fire, and although the first company that issued from the great doors in her bows was decimated, her iron sides protected the rest of the troops throughout the day and her machine gun battery fired on the Turkish trenches at point blank range. General Hamilton says of her: "This device, borrowed from the Iliad, was predestined to save my force from losses which hardly bear thinking about." It is a device which may well be used again on any rapidly shelving shore.

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In the naval operation as a whole a point to be noted is the effect of submarines. The first British submarine to reach the

Marmora dived under the nets and mines of the Dardanelles on the 25th of April. After that date and until the end of the campaign, with the exception of a few days, the British kept at least one submarine in the Marmora. The passage of the Narrows was successfully made 27 times. General Liman says that not once did the British submarines in the Marmora succeed in preventing maritime traffic. But this is certainly an exaggeration. It should be balanced against the equally exaggerated statement of Ali Riza Pasha, a Turkish General at Gallipoli, that after the submarine operations began it was only with the greatest difficulty that the Army could be supplied across the narrow neck of Bulair and from the Chanak side. The British submarines sank, as a matter of fact, 62 steamers and 148 sailing ships. One of their victims was an old battleship; another was a large transport carrying an infantry brigade and several batteries of artillery. So great was their moral effect, at least at first, that the Turks dared not transport troops even across the Dardanelles by day. It is true that the submarines could not sever the Turkish sea communications; but they did make those communications slow, hazardous and uncertain, and throughout the campaign they practically confined movement in the Marmora to the hours of darkness.

The German submarines also had a great effect on the campaign. Early in May the U-21 was sent through the Straits of Gibraltar into the Mediterranean. Soon after her presence in the Aegean became known the *Queen Elizabeth* was sent home. On the 25th and 27th of May she sank the *Triumph* and *Majestic* off the Dardanelles. After that the heavy ships were kept almost constantly in netted harbors. The battleships "offed it over the offing," in General Hamilton's picturesque phrase. The maintenance of the overseas lines of supply became very difficult. "All reinforcement, ammunition and supplies had to be brought up from Mudros to Helles or Anzac by night in fleet sweepers and trawlers," says Hamilton. Naval support to the troops on shore was thenceforth confined to the guns of light cruisers and destroyers, and of some new monitors which arrived towards the middle of July.

* * * *

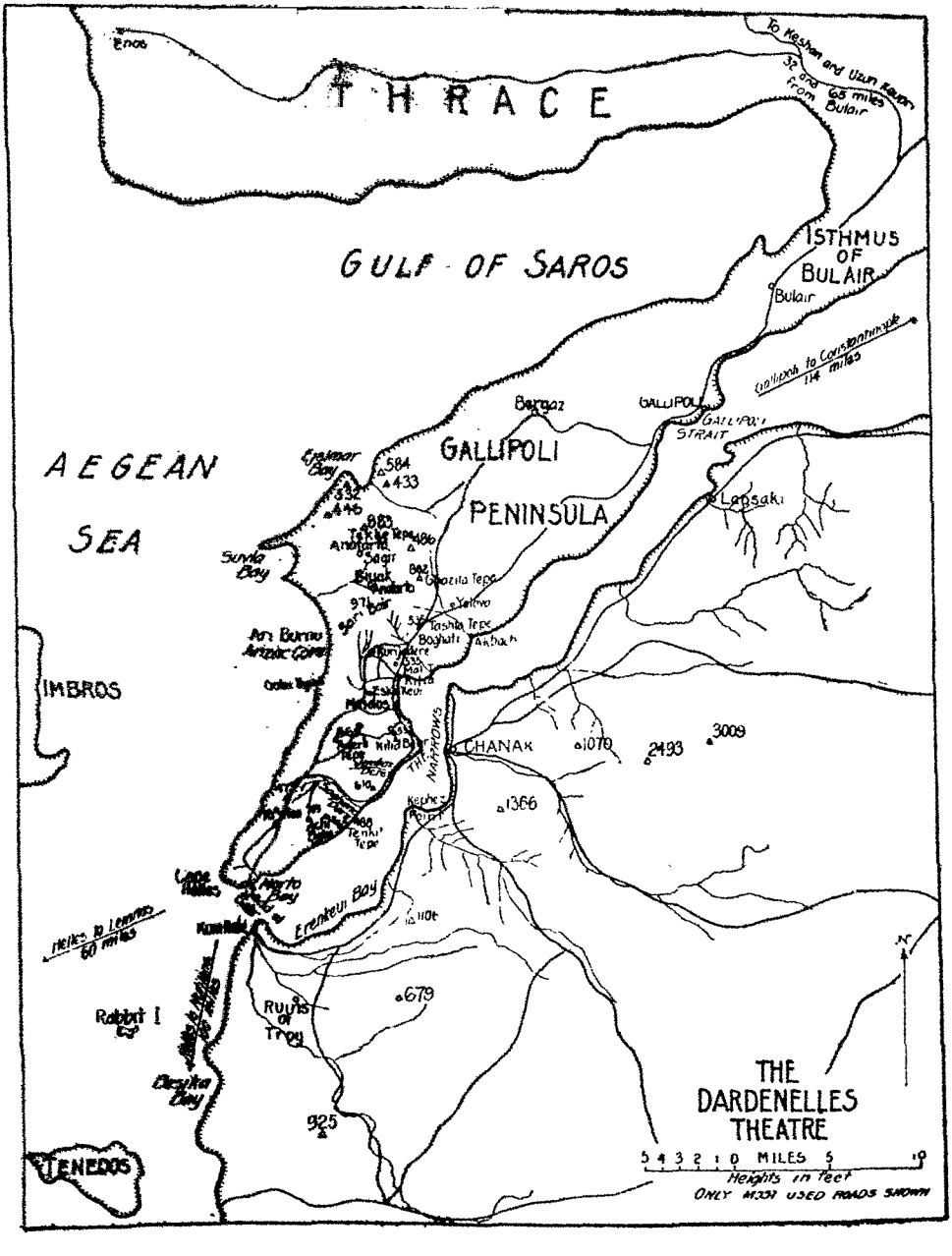
To a large extent the opposing armies were left to fight it out alone. The two navies played a relatively minor part. General Liman makes it plain that he got very little assistance from his German colleague, Admiral Souchon, who commanded the Turkish Fleet. It would appear that the larger Turko-German ships, particularly the *Goeben*, might have assisted in long range bombardments after the British capital ships had been driven to seek protection from the submarines.

Likewise General Hamilton's diary several times expresses his ardent wish that the British Admiral might find it possible to renew

the naval attack. A conception of professional etiquette which seems to have been over-scrupulous made the General refrain not only from asking the Admiral to attack, but even from suggesting it. Yet all during the campaign there were two schools of thought in the Allied Fleet. Admiral Wemyss, second in command and later Commander-in-Chief, and also Commodore Keyes, Chief of Staff, on several occasions urgently advocated the renewal of the attempt to force the Straits. Admiral de Robeck himself, on May 10th, intimated his readiness to make the attempt if the Admiralty would take the responsibility of giving the order. But it was not to be. The campaign was fated from the first to be, not a combined operation in the full sense of that term, but one of successive attacks, first by the Navy and then by the Army.

(To be continued)

Caught with a mere semblance of an army in 1917, our available forces had to be increased by an hundredfold, with no trained men to fill our ranks, and with resources still further unready. We were placed in a most discouraging dilemma. Our officials scarcely knew which way to turn. There was no plan to meet the problem and confusion reigned supreme. After a waste of six months, masses of men were herded together in a few quickly and expensively constructed cantonments, where they were sorted into units and their training conducted under the greatest difficulty. A year and more passed by before any one of our units took its place beside the Allies. This is no criticism of anyone; it was inevitable under the circumstances. The very same thing will occur again unless we plan otherwise. How any sane person today, in the light of these facts, can stand up and oppose any sort of preliminary preparation or training, is truly beyond my comprehension.—*Address by General J. J. Pershing to the Reserve Officers of New York.*


THRACE
Enos
To Keshan and Uzun Kaupri
Road 65 miles from Bulair
GULF OF SAROS
ISTHMUS OF BULAIR
Bulair
Gallipoli to Constantinople 114 miles
GALLIPOLI
GALLIPOLI STRAIT
Bergaz
GALLIPOLI PENINSULA
Lapsaki
AEGEAN SEA
Erelmar Bay
584
433
332
446
Sunda Bay
Ari Burnu Anzac Cove
Gaziula Tepe
Yelkiu
Tashla Tepe
Boghali
Akbash
IMBROS
CHANAK
1070
2493
3009
1366
Kepez Point
Erenteui Bay
Kum Kale
Rabbit I
Ruins of Troy
679
925
Besika Bay
TENEDOS
THE DARDENELLES THEATRE
5 4 3 2 1 0 MILES 5 10
Heights in feet
ONLY MOST USED ROADS SHOWN

EDITORIALS

THE JOURNAL'S NEW COVER

DURING the thirty-two years of its existence the JOURNAL has constantly made its bow to its readers from the inside of a red cover, except during the period of the World War, when it was impossible to obtain suitable stock. The Editor hesitated to depart from such a long-established custom, and really has not gone far afield, as can be seen from the Artillery border. However, it was felt that an explanation is due.

The change has been made primarily because the cover stock used during the past three years had to be made up especially for the JOURNAL and at least a year's supply ordered at one time. This called for a very considerable financial outlay. In addition to its being unusually expensive, the inside of the cover was very poorly suited to imprinting. The present cover is from stock that can be secured at a reasonable price in any quantity desired. Moreover, printed matter appearing thereon is especially easy to read. Under the circumstances, it is hoped the change will meet with the approval of JOURNAL readers.

COAST ARTILLERY REGIMENTS WITH CORPS AND ARMIES

After having occupied the Editorial chair for the past sixteen months and having during that period talked with a great many officers and read a great deal of copy, the Editor is impressed with the fact that some officers fail to realize that the Coast Artillery Corps has a mission in addition to that of firing upon moving naval and air targets—a mission just as important as fighting off enemy ships and enemy planes; and that is the mission of the Corps when operating with forces in the field. Coast Artillery officers and troops always have, and it is safe to say always will, operate with field armies during war. As unpleasant as the prospect may be, there is always the chance that this country may some day be invaded by a combination of enemies, or that circumstances may

again so shape themselves as to find the armies of this country fighting on foreign soil.

During the first days of a war the War Department Mobilization Plan provides, in addition to 274 harbor defense firing batteries, for nineteen antiaircraft regiments, six regiments of tractor-drawn artillery, and five regiments and one battalion of railway artillery, these to be manned by Coast Artillery troops of the Regular Army, National Guard and Organized Reserve. To what size these figures might grow would depend only upon the magnitude of the war. Just as soon as an enemy gained a foothold in this country, or in case of war on foreign shores, these antiaircraft, tractor, and railway artillery regiments would very largely be drawn away from the coast and attached to corps and armies. In addition when their services were no longer needed at our permanent fortifications many of the harbor defense regiments composed of batteries manning fixed guns would be assigned mobile weapons and likewise sent into the field.

Officers who have completed the Field Officers' Course at Fort Monroe and the Course at Fort Leavenworth have received sound instruction on the tactical employment of an antiaircraft regiment supporting a corps, on the employment of a 155-mm. G. P. F. regiment operating as corps artillery, and on the tactical disposition of a regiment of railway artillery supporting an army either on the offensive or defensive; in addition officers who have completed the Battery Officers' Course have some knowledge of these subjects. It is well, however, that we should not rusticate but should bear always in mind that in case of war the duties of a Coast Artillery officer are very apt to be with a unit operating with a Corps or Army. Unfortunately, in time of peace there is little opportunity for practical training of this kind, but constant visualization and study of these subjects by its officers, will insure that the Corps will render efficient service should the occasion demand.

THE BATTLE OF AYACUCHO

[Reprinted from the *Washington Post*]

One hundred years ago—December 9, 1824—the last vestige of Spanish power in South America was broken at the battlefield of Ayacucho, in Peru. The centenary of this great turning point in history is celebrated with appropriate ceremonies throughout the American republics.

The long struggle for independence on the part of the South American peoples bore much resemblance to the American Revolu-

tionary struggle. The Washington of South America was Simon Bolivar, whose towering genius in war and statesmanship was not satisfied with liberating a single nation, but sought to consolidate the entire hemisphere. He liberated and founded the republics of Bolivia, Colombia, Ecuador, Peru and Venezuela. He proposed a conference of the plenipotentiaries of all the governments of America, to be held at Panama, for the discussion and adjustment of disputes and the establishment of perpetual peace. He dreamed of a transoceanic canal at Panama, and carried his project considerably forward toward realization. Although possessing dictatorial powers, he refused to follow the footsteps of Napoleon or Iturbide, and voluntarily relinquished his powers as the republics liberated by him acquired experience and stability. All this he accomplished during a lifetime of 47 years.

Bolivar's victory at Boyaca on August 7, 1819, secured the independence of New Granada (Colombia). His victory at Carabobo on June 21, 1821, liberated Venezuela. At Pichincha, on May 24, 1822, he won the independence of Ecuador, through the genius of his chief lieutenant, Gen. Antonio de Sucre. Going thence to Peru, Bolivar defeated the Spanish forces under Gen. Canterac, and occupied Lima. He placed Sucre in command of Upper Peru; and there, at Ayacucho, Sucre met the Viceroy, Don Jose de la Serna, and the Spanish commander-in-chief, Gen. Jose Canterac, and overwhelmingly defeated them, thus liberating that portion of Peru which later became Bolivia.

The army of independence under Gen. Sucre numbered 5780 men at the battle of Ayacucho, of whom 4500 were Colombians, 1200 Peruvians, and 80 Argentines. The Spanish forces numbered 9310. The Spanish forces had chosen their position and possessed eleven field pieces, while the independents possessed only one—a four-pounder.

The battle lasted about an hour. The Spaniards lost 1400 killed and 700 wounded, among the latter being the Viceroy. The independents lost 307 killed and 609 wounded. Toward sunset Gen. Canterac sued for terms, and a treaty was drawn up and signed by him and Sucre. The magnanimity of the conqueror, set down in the very heat of battle, is a model that deserves the study of every military commander. The Spanish officers received passports and safe conduct and returned home via Callao and Buenos Aires. They had fought gallantly, cut off from the homeland and confronted with heartbreaking difficulties.

The task of organizing popular governments throughout the liberated regions was long and arduous. In the main it was skillfully

accomplished. The work of Bolivar, Sucre, and the other liberators stands solid and enduring. The United States, through President Monroe, thwarted European schemes for subverting the newly won independence of the South American nations, and Americans to this day stand united against any effort, under any pretext, to destroy the independence of any American republic.

Greetings and long life to Peru, on her natal day, and to all the peoples of this hemisphere, who stand ready to fight for their liberty, like their fathers before them!

PROFESSIONAL NOTES

Political and Economic Conditions in India

By Mr. C. C. Batchelder

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This subject is so extensive that I shall endeavor to confine myself to those aspects which are primarily of military importance.

According to the latest figures available to me, there were 77,626 Britishers serving in the British Army in India, and 229,731 officers and men in the Indian Army, all paid for from the Indian revenues. It is not thought that these numbers have been increased.

The total revenues for 1922-23 were	1,395,844.000 Rupees
The total expenditure charged to revenue	1,423,000,000 Rupees
Leaving a deficit of	27,156,000 Rupees
Of these expenses, the Army cost	670,236,000 Rupees
(The rupee is worth 32 cents).	(or 47% of the total).

It is extremely difficult to secure exact information regarding the military establishment in India, as the published figures regarding the personnel are always several years old, and the actual expenditures include not only the amount mentioned above, but also the proceeds of special loans, repayments of advances to the British government for military purposes, and purchases of supplies, and the direct and indirect contributions made by the Provinces and the native states.

It was stated in the Indian Legislature, without effective contradiction, that 60% of the total revenues of India were spent directly and indirectly on the Army.

The Indian Army is maintained for three purposes: first, for the defense of India against attack by land; second, for the preservation of order on the northwest frontier; and, third, to keep the 319,000,000 people of India under the rule of 122,919 Britishers.

Indian public opinion believes that Russia has been eliminated as a possible invader of India, that only a relatively small force is needed to control the marauding tribes on the northwest frontier, and bitterly resents the existence of such a large and expensive force to uphold alien rule.

The leaders of the opposition to the British government are constantly demanding in the Central and Provincial legislatures, and in the press, universal, compulsory, popular education, good roads, efficient sanitation, and an extensive program of public works and social betterment which would require annually more than the present total Indian revenue. The government is endeavoring to comply with these demands, but is greatly embarrassed by lack of funds.

Both the government and the opposition feel that further increases in taxation are inexpedient, commissions have made investigations to secure still further economies, and still the budgets continue to show deficits, without making any provision for social betterment. Efforts are being made to have the Provinces provide for education and sanitation, but as most of them have deficits, they cannot accomplish much.

Under these circumstances, it is inevitable that pressure should be brought to bear to reduce the Army still further. The Intelligentsia desires to see the whole British Army removed as unnecessary and disproportionately expensive, and the Indian Army, officered by Indians instead of British, reduced to the few divisions necessary to guard the passes leading to Thibet, China and Siam and the northwest frontier, so that the greater part of the 47% of the revenue now spent on the Army may be spent on education.

The danger is that the political situation in India may force the government to take steps in this direction.

As you know, the Indian Army has in the past been used abroad for Imperial purposes, and Indian troops have served in China, Africa and elsewhere, as they are well adapted to service in the Tropics and the Far East, and replace advantageously the relatively few and more expensive British regiments.

The British officers with whom I have talked say frankly that when the present program for further economies has been carried out, the extreme limits of safety will have been passed.

Indian public opinion is insistent that under no circumstances shall Indian troops be employed out of India during peace, and only with the consent of the Indian Legislature in war time. It demands, further, that the Army shall be planned only for the defense of India, and not for Imperial purposes.

Opinions differ as to the result, but many feel that for political reasons, it will not be possible, except in war time, to use Indian troops outside of India (thus they will not be available in case of disturbances in China, Egypt, and Africa, or in the countries like Mesopotamia which were formerly parts of the Turkish Empire); that the British Army in India will be further decreased, and that the numbers and efficiency of the Indian Army will be further impaired.

The Indian Army is managed by Indians, who have a status higher than noncommissioned officers but lower than those holding the King's commission. They can never rise to commissioned rank, but are often of good families of the second or warrior caste, and usually belong to the well-known fighting races. They are controlled by a small number of British officers of the usual ranks, who are ultimately responsible for discipline and efficiency and are often popular with their men.

The Indian press demands that these British officers should be rapidly replaced by Indians, and this is being done as rapidly as possible, for purely political reasons, by Indians trained in Sandhurst and in military schools in India. Some of them have told me that they expected to have trouble with the British officers, who are unwilling to mess with colored officers or to live in quarters with them, but they were astonished to find that the Indian noncommissioned officers were most unwilling to receive orders from other Indians, though they were quite willing to render the accustomed obedience to "Sahibs." One reason for this is that the new Indian commissioned officers often belong to the Babu class, largely from Bengal, who are detested by the fighting races. This matter of race and caste is one which must be considered in every relation of life. No one can predict what the results of these policies will be upon the

Indian Army, but all agree that its efficiency is being rapidly impaired by political interference.

As the present political situation in India dominates not only military affairs but practically everything else, it may be interesting to analyze it.

From 1612 when the British established their first factory in Surat, to 1919, the British first aquired control of India, and then ruled it by playing off one race or religion against the others. The only serious threat to their supremacy was in the Mutiny of 1857, which was put down by the Army with considerable bloodshed. There has never been any definite policy until recently, and government was carried on in a purely empiric manner by the personal ability of the relatively few Englishmen who went to India to rule. They confined themselves mostly to collecting the taxes and maintaining safety for life and property, through police and courts, and, with the exception of the necessary buildings, roads and railroads, there was but little attempt at social betterment except irrigation and famine relief.

There has never been any attempt at universal, popular education, such as we have in the Philippines; there is no widespread system of sanitation with hospitals, or provision for paupers, insane and dependents of various classes. Lepers beg without interference in the streets of Calcutta; smallpox, plague, cholera, typhoid, dysentery, not to speak of hookworm and other intestinal parasites, are so common as not to attract notice.

A person who has been a member of the government of the Philippines is astounded at the number of things which we started as necessary routine, which have never been attempted in India. The Viceroy and the governors of provinces are intensely interested in what we have accomplished, and the means we used in less difficult circumstances.

The secret of the success of the British rule in India is the small number of things which they attempted and the efficiency with which they administrated the fields into which they entered.

Before we condemn them, however, we must bear in mind the difficulties of religions, caste, manners and customs, and the poverty, dense population and immensity of the country.

As an instance of the difficulties, take the case of eliminating the rats which carry the plague fleas. A large part of the population objects, from religious reasons, to killing anything; mobbed the men engaged in poisoning rats in Bombay, and actually killed a few to discourage the others. The women of the upper and middle classes of most of the religions of India live in zenanas or harems, into which no man, not even a doctor, can enter, so house-to-house sanitation in time of pestilence is impossible.

With the exception of a few educated young men, the masses of India were apparently resigned to live their lives in the same manner as their fathers, and even resented any attempt to change, or even to improve their condition.

For a number of years, young men educated in England and other countries had been bringing back new ideas, and there was considerable agitation among the students in the universities, especially in Calcutta, but they were too few in number to produce any considerable effect.

Many Indians, however, served during the Great War in the armies of Europe, Palestine, Mesopotamia and other places, and still more worked as coolies in many lands, and all of them brought home new standards, new wants, and new ideas. Each of them who returned to his native village became a center of agitation for improved conditions, and for more modern standards.

Joining with the students, they succeeded in putting all India in a ferment. Many authorities feel that the unrest was largely economic in its origin, but we will discuss this aspect later. It is a question whether this agitation would not have subsided in time without serious consequences unless ably led, and this time the leader was not lacking.

M. K. Gandhi was the son of a member of one of the higher castes; received a good education in England and first became prominent by leading a movement in South Africa for equal rights with the whites for Indians living there. The matter was settled by a compromise, and during the war he raised an ambulance unit and was loyal to the government. In 1919, however, he instigated passive resistance in India as a protest against the "Rowlatt Bill" intended to assist in repressing sedition. This led to disorders in a number of places, as his followers did not follow out his doctrines and not content with rioting and burning the houses of Europeans, killed a number of them. The disorders were repressed by the military, and led to the so-called "Amritsar massacre."

Gandhi himself realized his mistake too late, and called it a "Himalayan Blunder," but the movement continued to gather strength until the whole country was disturbed and in one year the military were called out 67 times to repress riots which the police were unable to quell.

The striking thing about Gandhi is that he was able to accomplish what no one has been able to bring about in all its history. He united into a working organization millions of men belonging to hostile races, religions and castes. Upon closer analysis, the situation shows itself to be very different from what is generally believed, and the ultimate fate of the movement is explained.

Gandhi wrought no change of heart among his followers, he was unable to instill into them his own sincerity and unselfishness, or even to convert them to his doctrines. He did serve, however, as a rallying point for all who were dissatisfied, not only with British rule, but who were determined to better their economic condition by legitimate or illegitimate means. His followers included not only those who were working for Indian independence, but gangsters who desired to profit by the opportunities for looting given by the strikes and boycotts, and many hot-headed young men who found processions and picketing an outlet for their love of change and of adventure. It has been found that many who took part in this movement were paid from the party funds.

The one new feature was the fanatical religious movement among the Mohammedans called the "Khilafat Movement." This was based upon the belief that the British intended to partition Turkey practically out of existence, and deprive the Sultan not only of his temporal power, but of his functions as head of the Mohammedan faith. The Greek offensive against Angora, the hostile relations between Angora and the British, and the failure of the attempts to restore Turkey to its pre-war status, roused religious feeling to an extent which we have difficulty in realizing. Many Moslems had served in Palestine and Mesopotamia against the Turks, who were their co-religionists, in consequence of promises made them that nothing would be attempted against their faith, and they felt that all these occurrences were breaches of these promises. Seditious articles appeared in their papers, and the Ali brothers, who were two of Gandhi's chief lieutenants, openly endeavored to incite the native troops to rebellion, and advised their followers to join the forces of the Amir of Afghanistan, who had declared war against the British, and at least to refuse any aid to the British. The abolition of the Khalifate by the Angora assembly removed this grievance and was a severe blow to the agitators.

It is impossible to understand the situation in India without an analysis of the personality of Gandhi, who in some respects resembles Peter the Hermit, who preached the Crusades. His blameless life, religious fervor, sincerity and enthusiasm had earned him the title of "Mahatma," or saint. He clearly believed in himself and his mission to regenerate India, and was able to convert millions of his countrymen to his beliefs. His immediate object was the independence of India, and the removal of the British government which he called "satanic," but his ultimate ends were much more radical, and contemplated the elimination of the whole fabric of Occidental civilization.

He preached that western education developed slave mentality, that doctors deepen degradation, that hospitals propagate sin, that law courts and legal practitioners unman those who resort to them, that railways carry man away from his Maker, and that modern civilization should be eradicated like the plague.

In order to accomplish this, he advocated the boycott of railroads, postal service, schools, courts, and of all manufactured goods and products of the Occident. Now this was not merely eccentricity, but based upon fundamental religious concepts which have prevailed in India for centuries, and resemble to some extent certain beliefs of the Middle Ages in Europe.

The belief is widely held in the Orient that the human soul returns to earth after death, sometimes as another man, and sometimes in the body of an animal. Life is filled with suffering, with very little happiness or even pleasure, and the way to escape the ills of existence is to adopt means to stop rebirth. This is to be accomplished by plucking out of the inmost personality every desire for enjoyment, possessions, even for life itself. The only thing that is worth while is the development of the individual soul, and this is hindered by pleasurable sensations and by all striving after any material object. Nothing could be more opposed to our ideas. According to these beliefs, it is morally wrong to struggle for progress, not to say comforts and luxuries. We should bear the ills of life with indifference instead of trying to right them.

Not only Gandhi himself, but tens of millions in India genuinely believe these tenets and some even try to put them into practice. With this ideal in mind, Gandhi preached as a first step the use only of cloth that is spun and woven by hand, and urged all his followers to devote a certain number of hours a day to the spinning wheel. No foreign cloth was to be used, and in many cases his followers, not content with refusing to buy it themselves, raided the shops of merchants who had stocks of it, and burned it in the streets so that others could not wear it.

His request that the government schools should be boycotted met with considerable response, thousands of young men and children gave up their education, and swelled the ranks of the agitators who went from place to place urging opposition to British rule. In many places agricultural and industrial laborers deserted their jobs, and in certain places the situation became serious.

His first object was the establishment of *Swaraj* or independence by the elimination of the British, and this was to be obtained by refusing to cooperate with the government in any way. Government employes were urged to leave their jobs, taxpayers were to refuse to pay their taxes, no one should make use of any activity of the government, which would in time voluntarily withdraw.

Warned by the Amritsar massacre, he continually preached nonviolence, but this doctrine was never accepted by his followers, especially the Mohammedans, and riots and insurrections of various kinds were continually occurring.

The Moslem population of Malabar rebelled and endeavored to form an independent kingdom. The situation was so dangerous that four battalions, one

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pack battery, a section of armored cars, and the necessary supply services were required to suppress it, and the rebellion lasted nevertheless from August 20, 1921 to February 25, 1922.

The situation became so serious all over India that British rule was threatened, and some Britishers even sent their families home and sold their property to natives, anticipating a repetition of the mutiny.

The government of India has been greatly criticized for not adopting repressive measures sooner, but its reasons as stated in an official statement of November, 1920, should be given careful consideration. It states that, while it regarded the movement as unconstitutional, no proceedings had been instituted against those of its promoters who advocated abstention from violence, because the government was reluctant to restrain freedom of speech and liberty of the press at a time when India was being given greater self-government; second, that the government was reluctant to proceed against individuals who were actuated by honest, if misguided, motives; third, that such proceedings might make martyrs of the subjects of them, and increase their adherents, and further, the government trusted to the common sense of India to reject such a chimerical scheme. It also stated that repressive action against the non-cooperative movement could be postponed only as long as moderates were able to keep its dangers within bounds. Many people feel that it was this moderation which rallied to the government such a large body of the more intelligent liberals, and made it possible to elect successfully the members of the various legislatures, in spite of the social pressure and intimidation brought to bear by the Non-cooperators.

The tolerant attitude of the government was carried so far as to permit the organization of the National Volunteers, some of whom drilled, marched in mass formation, wore uniform, and carried out extended strikes, boycotts and intimidation. Many hooligans and bad characters enlisted, and soon most of the volunteers were receiving regular or occasional pay from the Tilak fund. This is important as most people have believed that the disorders were the spontaneous expression of the Indian masses. Although Gandhi preached non-violence and advocated putting spiritual pressure on the government by fasting, his followers constantly resorted to open violence.

Following the orders of the Viceroy, Lord Chelmford, and the Secretary of State for India, Mr. Montague, a policy of moderation and tolerance was enforced. Officials who were too vigorous in repressing disorder were transferred to less desirable posts or even officially reprimanded, agitators were allowed to preach sedition practically without interference, and the press was filled with seditious articles.

Now for generations India has been ruled by the Indian Civil Service, a corps of permanent officials, who collect the taxes, run the police, try cases and conduct the administration. They thoroughly disapproved of these new policies and predicted failure.

Finally, the views of these experienced men prevailed, a reversal of policy was ordered and Gandhi was arrested by the order of the new Viceroy, Lord Reading. Many observers felt that India would burst into open revolt, but there was not a ripple. He had lost the support of large masses of his supporters by his refusal to permit mass civil disobedience, *Swaraj* was not secured on the promised date, people were alienated by his raising 10,000,000 rupees, and the more intelligent supporters saw the dangers of the movement. The Indian peoples are very ignorant and emotional, their support has been secured by systematic misrepresentation and the movement had run its course.

The aims which the British have in view are best set forth in the message from the King delivered by the Duke of Connaught to the Indian Legislature on February 9, 1921:

> For years, it may be for generations, patriotic and loyal Indians have dreamed of *Swaraj* for their motherland. Today you have the beginnings of *Swaraj* within my empire, and widest scope for progress to the liberty which my other Dominions enjoy.

In other words, it is clearly planned to give India Dominion self-government on the plan of Canada and Australia. Many people question whether this will be possible in view of the hostile races and religions, but it must be said that the new legislatures have been rather successful and that no dangerous conflicts with the executives have developed, though there has been increasing opposition to the government and some serious deadlocks.

Quite a number of Britishers and foreigners who have made careful studies of the subject are convinced that the resources in men and materials of India are essential to the British Empire, and that the loss of India would mean the dissolution of the Empire. Apart from powerful sentimental motives, the Dominions are held to the Empire largely on account of the protection afforded them by the British fleet. If India were lost, it is a question whether Great Britain could sustain the taxation neressary to keep her in her position of a first-class world power.

The great danger to the future prosperity of India is the strained relations existing between the Indians and the British, which many observers feel are largely due to economic causes. The fundamental fact which dominates the political and economic situation in India is the utter wretchedness of the Indian masses. Few investigators believe that the annual income per head exceeds $30, and of this 60 to 70 per cent is expended on food, 8 per cent on clothing and 12 per cent on rent, in the cities.

Indian opinion is convinced that the condition of the lower classes is constantly growing worse, while the government vigorously combats the idea and shows that wages have increased 90 per cent since the war for men in Bombay, while the cost of living had increased only 67 per cent, showing a net gain (from weighted figures) of 14 per cent.

A physical inspection of the bodies of the masses inclines one to the belief that they do not get enough to eat. About 27 per cent of the population is engaged in agriculture, using almost universally primitive implements, and the dominant feature is the fact that if they received their total product as wages, with no deductions for rent or interest, the sum would not be adequate to maintain the family, even in the low standards of the Japanese laborer. Under these circumstances, it is only natural that agitators are able to get support for anything that promises social betterment. Much of Gandhi's support came from the fact that his representatives promised that "Swaraj" (independence) would be the golden age when prices would fall, taxes would not be levied, when each man should be free from all state fetters, free to do that which he would with his own—and his wealthier neighbors' property.

The underlying fact that dominates both political and economic conditions in India is the great increase in population (54 per cent in the last 50 years) without a corresponding increase in the production of food. The Indians recognize this in their proverb "every twenty years there must be a famine, a war or a pestilence—of these, war is best, because while some suffer, others profit." The only remedy for the situation is a great increase in agricultural production by

the use of fertilizers, improved machinery and implements, seed selection, rotation of crops, and in general scientific agricultural methods, and the substitution of power-driven agricultural machinery for human and animal muscles. At the same time, the industrial resources of India must be developed with the assistance of the abundant coal and hydro-electric power.

The British are just beginning to recognize that the giving of Dominion self-government to India will not be sufficient to solve their problems. Economic development is even more necessary than political independence. The difficulty is that they do not have the trained men that are needed, as the cultural education given at Oxford and Cambridge has not developed men of the type which is needed today. Engineers are few because that profession has not appealed to the more intelligent Britons. Indian public opinion is suspending its judgment, and is waiting to see whether the Britsh wlll be able to work out a form of government within the Empire which will satisfy the political aspirations of the Indians, and at the same time develop the resources of the country, and improve the intolerable condition of the masses.

Before the arrest of Gandhi, many people felt that British rule in India was doomed. Now the same people feel that it is stronger than ever. The British have again shown that administrative ability which has enabled them to acquire and govern their numerous possessions, and will probably be able to hold India indefinitely if British public opinion will permit the Indian government to take the measures which may be necessary to repress sedition, if it occurs. Never again, however, will it be possible to govern India arbitrarily. The administration, hereafter, must be carried on with the consent of the governed.

A Critical Survey of the Advances in Practical Ballistics in the Ordnance Department, U. S. Army, Since 1917

By 1st Lieut. Philip Schwartz, *O. D.*

In general, artillery ballistic problems of the Ordnance Department are:

(a) The conduct of range firing.

(b) The preparation of range tables.

(c) The advancement of ballistic theory and practice.

(d) The improvement of projectile design with respect to range and accuracy.

In order to understand what improvements have been made, it is necessary to describe some of the faulty methods which were in use early in 1917.

In range firings which were conducted at Sandy Hook Proving Ground, ranges and deflections were computed by direct trigonemetric solution of triangles formed by the observed azimuth readings. Usually, three observers read on the splash and four timekeepers measured the time of flight. Strangely, the time of flight filled five columns of the firing record sheet and the range only one, yet the time was not used at all in computation. In fact, the measured time was not considered to be as reliable as the value computed through the ballistic tables (Table II of Artillery Circular M), on the basis of the measured range. It was customary to measure velocity on all range rounds and as a result of this and of other disturbing conditions, range firing was usually limited to a few rounds per day.

The question of the use of the proper number of significant figures in ballistic computation seemed to have been considered unimportant. In the range tables

of the period one may find quantities given to two or three more significant figures than their accuracy warranted. The ballistic coefficient was sometimes tabulated to six figures, the drift to tenths of a minute and the range to tenths of a foot. Computations appear to have been conducted with the aid of five or seven place logarithm tables, which may explain the presence of the extraordinary number of figures in the tabulated values. Interpolation formulae were used wherever possible, even though graphical methods would have been sufficiently accurate, and shorter in time. Range correction charts for Pratt boards were computed for eight heights of site in order to take into account the effect on the velocity, atmosphere, and wind correction, of variation in the height of site. At present one chart for all heights is considered satisfactory.

Meteorological corrections were made on the basis of surface measurements only. Range wind was corrected for in army range tables by the use of the factor $fw = 1 \pm \frac{2\, W_X\, T^{5/4}}{X}$ in the ballistic coefficient, where W_X was the surface range wind, T the time of flight and X the range. This factor was supposed to take care of wind aloft by assuming a definite increase in speed of the wind with altitude, but, however, no change in direction; several other approximate assumptions were made in determining this factor. Air density corrections were made entirely on the basis of surface conditions, without considering variation of density aloft from standard conditions. Corrections for temperature, although known to effect the retardation, were never applied, chiefly because no accurate means of doing it had been invented.

For high angle low velocity fire of mortars and howitzers the quadratic law of air resistance was assumed to be sufficiently exact, ballistic tables based on this assumption being used in making mortar and howitzer range tables.

High velocity guns were fired at low angles always—seldom above 15°—and Ingalls' Table II of Artillery Circular M, based on the Siacci approximations, was used in constructing range tables. As used in the United States, the Siacci approximations were two. The first one consisted in assuming that in the solution of the differential equations of motion $\frac{\cos^{n-2}\phi}{\cos^{n-1}\Theta}$ could be replaced by a constant β where ϕ, Θ, and n, were the initial angle of elevation, angle of elevation at the point, and exponent of the velocity in the retardation law at the point, respectively. β was the constant of integration and was assumed to differ from 1 by very little and was sometimes approximated, if necessary, by $\sqrt{\sec\phi}$. The second approximation consisted in assuming that the average decrease in air resistance caused by the decrease in air density with increase in altitude, could be taken care of by the f_a factor in the ballistic coefficient; f_a was computed, if necessary, as the reciprocal of the ratio of air density at the mean height of the projectile to the ground density, and it also differed from unity by very little, for low angles of fire. Colonel Ingalls had computed Table I on the basis of the Siacci approximations, and Table II also, in order to arrange the values in a manner suitable for rapid use. The standard ballistic coefficient as used with Table II was therefore $C = \frac{W\ f_a \delta\ f_W}{i d^2\ \beta\ \delta}$ and the problem in range table construction consisted in determining values of $\frac{\beta\ i}{f_a}$ for the various angles

of fire, since all other quantities could be determined on the basis of these values.

Range tables lacked many important items. No probable error column was given. No column for change in range due to change in weight was given. The drift and range were not known accurately because they were not corrected to standard conditions accurately. In tabulating time of burning of fuses against fuse setting, no allowance was made for the change in rate of burning with elevation. Other poor features have been mentioned previously.

As for the advancement of ballistic theory, very little was accomplished. The air resistance laws determined by foreign countries was adopted. On account of lack of appropriations for extended firing it was found convenient to let foreigners do the firing and have the officers of the United States Army employ their time in mathematical research. This research was of an engineering nature, and consisted usually in trying to discover empirical formulae to express the results of firings, or in making more or less accurate extensions to the Siacci theory.

What little firing was done in connection with the improvement of projectile design with respect to range and accuracy, consisted usually in firing a very few rounds on any day at low elevations. Consequently, little was learned concerning the refinements in projectile design which are becoming so important for high angle fire. Since at low angles of elevation and low velocities the range obtained is close to the vacuum range, a large change in the form of the shell or in its ballistic coefficient is required to produce an appreciable change in range. On account of the few rounds fired no accurate value of the dispersion could be obtained.

Summarizing, it is seen that the following conditions existed in pre-war ballistics. Range firing was not done in an efficient manner. Range observing, computing, range table computation and all computing in general were not conducted on a truly scientific basis. The fundamental ballistic theory was either deficient or approximate in important respects and questions of refinement of projectile design were considered unimportant on account of the low firing elevations.

With the advent of the war, new problems appeared which could not be solved directly by the old methods. The first important problem was the computation of antiaircraft range tables to give the characteristics of the trajectory at any point, for use with antiaircraft guns which shot at high velocities and at all angles up to 90°. At Sandy Hook, Colonel Alston Hamilton, devised a method of computing high angle trajectories by applying the Siacci approximations to the computation of trajectories by small arcs. As first tried, the method did not contain the f_a factor. By placing this in its proper place Lieutenant P. L. Alger was able to produce several abridged antiaircraft range tables containing the characteristics of the trajectories up to 90° but not having important columns giving differential corrections. In addition, Lieutenant Alger improved the computation of ordinary range tables, and directed the publication of a revised edition of Artillery Circular M. He also worked up a set of charts which permitted a simple computation of differential corrections for low angle fire, based on the Siacci approximations. (See COAST ARTILLERY JOURNAL Vol. No. 51, No. 6, "Charts for the Calculation of the Effect of Small Changes in the Elements of Fire," by 1st Lieut. L. L. Alger.)

As information from our allies was sent to this country it began to appear that modifications in our ballistic methods would have to be made, to make them

conform with the latest information on the subject. When it became known that the English and French were measuring wind and density aloft and using these values of the meteorological conditions in making their corrections, we decided to copy their methods. The Signal Corps was asked to supply a method of measuring wind aloft. Accordingly, in the winter of 1917-18, a Signal Corps detachment was sent to Sandy Hook for the purpose of making these measurements. At first only the time average wind from the ground to the maximum ordinate was used in making wind corrections. Time weighting factors were also tried. An attempt was made to calculate exact weighting factors but the Siacci method would not lend itself to this process easily, nor was Hamilton's method of computing trajectories sufficiently simple for this purpose.

During the winter of 1917 Captain Oswald Veblen of Princeton University and Major F. R. Moulton of Chicago University, were added to the Proving Ground and Washington ballistic staffs respectively. The question of producing reliable antiaircraft range tables induced Major Moulton to investigate foreign methods of computation. In May of 1918 he tried out a method of computing trajectories analogously to the manner in which orbits of celestial bodies are computed. He set down the differential equations of motion of a projectile as follows:

$$x'' = -Fx'$$
$$y'' = -Fy' - g$$
$$F = \frac{G(v)H(y)}{C} = \frac{R}{v}$$

where x'' and y'' are the horizontal and vertical retardations respectively, and x' and y' the horizontal and vertical velocities at any point, R the retardation of the air, v the velocity, g the acceleration of gravity, $C = \frac{w}{id^2}$ the ballistic coefficient, and H(y) the ratio of the density of the air at the altitude y to the density at the ground, for standard conditions. This method involved the breaking up of the trajectory into a large number of short arcs, and integrating the differential equations of motion numerically over each short arc, taking into account first, second, and third differences. The method proved an instant success, both with respect to increase in accuracy of computation, and also with respect to gain in time in comparison with other short arc methods. However, the computation of differential corrections was still a tedious process even by the method Major Moulton derived for use with his trajectory computations. (See Coast Artillery Journal Vol. 51, No. 1, "Numerical Integration of Differential Equations" by Major F. R. Moulton.)

Major Moulton assembled a staff of mathematicians from the universities of the country. They aided him in making the short arc method practical and acceptable, constructed and improved range tables, and investigated ballistic problems. Captain Veblen had obtained a staff of equally prominent mathematicians and physicists at Aberdeen Proving Ground, where they investigated the problems that were set before the Range Firing Section. These consisted in range firing, constructing range tables, investigating projectile design, and questions connected with ballistic theory and practice. Professor G. A. Bliss of Chicago University, then on the staff of the Range Firing Section, devised an ingenious system of computing differential corrections to Moulton's trajectories. The method involved the computation by numerical integration of several aux-

iliary variables which permitted the computation of differential corrections for the point of fall by a simple formula. The mathematical theory involved in the derivation was of a very high order. A few months later he extended this method to the computation of antiaircraft differential corrections. Thus the problem of computing high angle trajectories and differential corrections was solved and trajectories and differential corrections could be computed for any conditions of fire. In addition, by Bliss' method, exact weighting factors should be computed simply; the effect of rotation of earth could also be computed. From this time on, proving ground firings were corrected using exact weighting factors. Corrections and weighting factors for density and temperature could now also be obtained accurately. (See COAST ARTILLERY JOURNAL, Vol. 51, No. 3, "The Use of Adjoint Systems," by G. A. Bliss.)

It is important to note that the results of computation by numerical integration methods, although mathematically exact are no more accurate than the accuracy permitted by the experimental basis of the theory, and it is well known that the resistance laws as at present tabulated, are inaccurate in several respects. The resistance laws are based on firings with projectiles whose shape is now obsolete, and recent investigations using wind tunnels, have proved conclusively that the resistance law depends on the shape of the projectiles used. That is, the important assumption that the ratio of the retardations of two projectiles of different shape is independent of the velocity is inaccurate. The resistances as originally measured were not corrected for variations in the elasticity of the air during the course of the firing. The projectiles used were about three calibers in length and were therefore more stable than the projectiles now in use, which are longer. It is to be noted that no definite law was ever determined; the firings merely indicated a zone in which the resistance law lies for the particular kind of projectiles used. In this respect, values obtained by the short arc method are no more accurate than those obtained by the Siacci method, within the limits of use of the Siacci method, namely up to 15° elevation. Ballistic tables based on short arc computations are now being computed, and when they are published will undoubtedly do away with the use of Ingalls' tables. But until the time when the new tables are available for general use, it is believed that Ingalls' tables may be used to solve most of our problems even for fire up to 45° elevation. There is no particular gain in accuracy obtained by using a smooth retardation curve instead of Mayevski's straight lines. Inaccuracies in the air resistance law, as at present known, are such that either a series of straight lines or a smooth curve as determined by the Gavre Commission may be used and neither curve would have any *appreciable* advantage over the other. The retardation laws which exist are all based on firings whose results extend over such a zone as to permit the use of different laws. The ballistic coefficient as at present obtained from firings, varies with elevation and velocity, particularly at low elevations, where the effect of errors in the resistance law is seen in computing the ballistic coefficient from range firings.

The benefits of the results obtained from computations by short arc methods may easily be overestimated by those who have not looked into the matter critically. Mathematicians may say that the Siacci method is based on poor and complicated methods and that army officers have been kept away from the study of ballistics on this account. However, a casual glance at the published papers on the short arc method and the method of computing differential corrections, will not bear out this statement. A complete understanding of the mathematics of the new methods including the differential corrections, involves an understanding

of a great deal of higher mathematics. The opinion has been expressed that pre-war methods were to make firings at all elevations and thus really not need any good mathematical theory—merely a table for interpolation purposes; but this procedure is still being followed and will be followed even after the new tables are published, for ranges are not known any better now from *a priori* reasoning without firing, nor does firing at one elevation determine such a short arc value of the ballistic coefficient that it can be used accurately for all elevations. The short arc theory says merely that assuming a given retardation law, corrected range, measured initial velocity, and angle of departure, and assuming that the projectile can be represented by a particle of the same mass, concentrated at the center of gravity of the projectile, a ballistic coefficient $C = W/id^2$ can be determined. Using this coefficient and the measured initital velocity and angle of departure, the corrected measured range will result from computation of a short art trajectory. Owing to the assumptions involved in constructing the air resistance law and in the representation of the projectile by a particle, little can be said concerning the actual practical accuracy of the other computed characteristics of the trajectory such as maximum ordinate, time of flight, striking velocity, etc., except that within the limits of the assumptions these characteristics can be computed as accurately as is desired. Whenever the motion of a projectile considered as a rigid body has been completely investigated and the results put in a usable form, it will be possible to cumpute accurate characteristics for all points of the trajectory in addition to the initial and final points. Another assumption which affects the characteristics of the trajectory is that short arc computations are usually based on an expotential altitude air density law which is not exactly the average density law. The reason for the use of the expotential law is for ease in computation. The new tables will give in addition to characteristics of the point of fall and summit, the characteristics at any point of the trajectory and in this way permit computation of a change in elevation for a given range due to an angle of site, accurately. The data required for construction of antiaircraft range tables, differential corrections and exact weighting factors curves will also be given.

Rigidity of the trajectory was not one of the assumptions of the Siacci method, and errors in the application of this theory should not be charged to the Siacci method. However, the rigidity theory, plus a complementary angle of site theory, is still sufficiently exact for many purposes since the target is not usually on a level very much different from that of the gun. It is only in antiaircraft, howitzer, and mortar fire, where the Siacci theory is admittedly not to be used, that the theory of the rigidity must be entirely discarded. The short arc method is well adapted for problems connected with fire from airplanes. The question of rotation of earth, the effect of which can now be computed accurately, is of little importance in more than 95 per cent of battle firing. The Siacci method should also not be blamed for the past ignorance concerning the use of upper air meteorological conditions, for except for the knowledge of exact weighting factors—which will probably never be usel by artillerymen in the field—the accurate correction for wind and density can be computed by the Siacci method whenever the differential corrections for air density, elevation, and velocity, are known accurately.

The new ballistic tables will not be published until late in 1924 and then only the part of lesser importance. There exist at present French short arc tables called the A. L. V. F. Tables and also French short arc charts which give the important characteristics of the summit and point of fall for varying initial

elevation, velocity, range, and ballistic coefficient. The A. L. V. F. Tables have been translated and published, and are being used until the new American tables are published. However, there will be no short arc table of differential corrections in existence for several years, unless as has been suggested, a set of differential charts analogous to the French charts is prepared on the basis of the A. L. V. F. Tables and the French Charts. For most purposes such charts would give as much accuracy in the differential corrections as is required and they could easily be given as a function of the three variables, range, elevation, and velocity.

For practical purposes, ballistic tables appear to be useful mainly because they permit the computation of the corrections in the range of a projectile due to variation from standard conditions. Also range tables are usually based on firings in one gun or in a limited number of guns and for this reason do not apply to any gun. Each gun has a calibration error and this error may run as high as 2 per cent at the maximum range. The range drum on any gun is not set so as to take into account the error of the gun in question. It is conceivable that it would be advisable to spare artillerymen the trouble of calibrating their guns by testing the range as well as the strength of the gun at Ordnance Proving Grounds and firing a few rounds from it in comparison with a few from a standard gun. Recent firings at Aberdeen have shown considerable variation in range from gun to gun of the same model and caliber when fired at the same time under exactly similar conditions.

It appears that a knowledge of the differential corrections is of primary importance in ballistic tables and that one of the measures of the utility of any ballistic table is the accuracy with which the differential corrections are known. A rough comparison has been made of differential corrections taken from the A. L. V. F. Tables and the same quantities calculated from Alger's differential charts. The comparison shows that for angles up to 20° the difference between the Siacci value and the short arc value is about within the limit of error of the assumptions underlying both theories, probably because at low elevations where vacuum conditions are approached, the trajectory and differential corrections in air are not very different from those in vacuum. The comparison also shows that for low velocities or up to 2000 f.s., probably for the same reason as for low elevations, the values computed by both methods agree fairly well. Even for angles up to 40° and for velocities up to 1600 f.s., the Siacci value agrees well with the short arc value.

The computation of range tables has been developed along scientific lines. The question of the accuracy with which a quantity can be determined is considered before computations are made in order to decide whether a slide rule, a four place, five place, or seven place logarithm table is required. Calculating machines have been introduced, thus causing a great saving in time and labor. One of the aids in making the short arc method by numerical integration practicable, was the Monroe calculating machine. The slope of the curves giving variation of the different functions with elevation is well known. Graphical methods are now in general use. The convenient mil unit has been used in range tables. The order of tabulation of quantities in a range table, the intervals of range used, the number of significant figures have all been standardized in a logical manner so that the artilleryman can make efficient use of the range tables. Additional aids are placed in the introduction where a description of the ballistic properties of gun and ammunition is found and where there are placed illustrations of the use of the range table. (See Army Ordnance Vol. II, No. 10, "The Construction of a Range Table" by F. L. Carmichael)

The conduct of range firings, has also been systematized scientifically. In order to avoid errors incident to the use of panoramic sights, their use is not recommended, and for aiming in azimuth, bore sighting is resorted to. Lines of fire are carefully measured using transits so as to take into account any existing cant of the trunnions of the gun. In order to permit a large number of rounds to be fired in a short interval, velocity measurements are usually taken on only a few rounds and their mean assumed to be the mean velocity of the range rounds. Instead of using the trigonometrical solution of triangles for computing ranges, a system of coordinates has been devised and large scale maps of the area in which range firings are conducted have been drawn in such a way as to permit plotting the range and reading it with less than one tenth of one per cent error in a very short time. The computation required in connection with measuring ranges has been reduced to a minimum. Plotting of ranges permits a logical method of rejecting poor readings and of picking out the most probable range when all of the observed azimuth lines do not intersect in a point. As far as possible all of the customary refinements of the physical laboratory are being generally introduced so as to let no avoidable errors creep into the work.

The time of flight is not measured except in firing projectiles which are equipped with a time fuze. The accuracy and utility of the measured time of flight are interesting subjects for discussion. There are two quantities which cen easily be measured at the point of fall, range and time of flight, and it is reasonable to believe that a mechanical device for registering the time of flight as accurately as the range is now measured, can be devised. By correcting the measured correct time to standard conditions, a time ballistic coefficient could be determined, which when averaged with the range ballistic coefficient, would permit the computation of a trajectory more nearly the actual trajectory than when the trajectory is based merely upon the range ballistic coefficient. Such a procedure may give a quantitative measure of the practical accuracy of the underlying assumptions of the ballistic theory; the range and time ballistic coefficients should be the same. It is conceivable that with a good air resistance law, a stable projectile, and an automatic method of measuring time accurately, observation of ranges could be dispensed with, and by correcting the time of flight to standard conditions, compute the range through the medium of the time ballistic coefficient just as the time is now computed with the aid of the range ballistic coefficient.

The importance of upper air meteorological conditions has already been mentioned. This question, which is not yet completely settled, has been an important reason for the organization of a new section of the Signal Corps of the army. As for measuring the wind aloft by following the path of pilot balloons with theodolites, investigations with sensitive anemometers, indicate that the wind changes rapidly from moment to moment—especially at low altitudes—and that the path of the balloon does not represent an actual wind blowing the balloon along; the balloon may merely be following the average wind and the effect on the path of the projectile of these momentary winds may be different from the effect on the path of the balloon. One foreign country has considered the question of vertical wind and has assumed that when the pilot balloon does not ascend at the predicted rate, that a vertical wind has caused the departure. The effect of a vertical wind on range is very noticeable at low angles of elevation, even for winds of small magnitude. In this country vertical wind is assumed to be a negligible quantity.

Some doubt concerning the accuracy of the elasticity temperature correction is still held because of its peculiar weighting factors, and because the

elasticity correction does not always appear to make the results of wind tunnel experiments as reasonable as when uncorrected, but principally on account of the inaccuracy of the air resistance law.

Field Artillerymen in the United States have not yet brought themselves to the point where they believe, that under battle conditions, it is always advisable to make ballistic corrections before firing. Coast artillerymen believe that correcting before firing is a good thing, but they object to adding any burdens of computation on the battery commander's shoulders. The most accurate method of correcting ranges involves the computation of ballistic values from observed values by means of weighting factors just before firing is commenced; it is at this time that battery commanders are pressed for time and the target may move from an advantageous position during the time spent on computation. However, they are willing to use weighted ballistic values if it is possible to obtain them some time before firing is commenced, and especially if the meteorological section can be prevailed upon to make the necessary computation. It would be an impossibility to send out, periodically, ballistic values based on exact weighting factors, since each caliber of gun, velocity, shell and elevation requires a different set of factors. This difficulty has already been settled by one foreign country by the use of a mean weighting factor curve obtained as a mean of the curves for all of the guns likely to use weighting factors. In the United States it has been proposed to use three sets of factors but even this number is considered large. One mean weighting factor curve has been used since 1921 by the Coast Artillery. (See C. A. JOURNAL, Vol. 53, No. 6, "Wind Weighting Factors," by 1st Lieutenant J. J. Johnson, C. A. C.) The mean curve of all exact weighting factor curves for most of the guns used in the United States is only slightly different from the time weighting factor curve. However, even if artillerymen should decide to use only approximate weighting factors, this should not affect procedure in construction of range tables and in all work where quality and not quantity is desired. At Ordnance proving grounds exact weighting factors should always be used especially in the preparation of data for constructing range tables.

It is interesting to note that at Aberdeen errors in computation or observation of ballistic wind have often been found by the resulting abnormal drift. Methods of measuring atmospheric conditions aloft have not yet progressed so that the values can be measured at any time or at any height. The pilot balloon method of measuring wind has very serious limitations which prevent data from being obtained during hazy weather and to sufficiently great altitudes. It has been proposed to use box kites at such times, but this method has not yet been developed to a practical point. An experimental investigation of the effect of wind upon range and deflection has recently been carried out at Aberdeen. The results have shown that the theoretical formula, based on the relative wind, is as accurate as can be expected. (See C. A. JOURNAL, Vol. 60, No. 2, "Experimental Investigation of the Effect of Wind upon the Motion of a Projectile," by Lieut. P. Schwartz.). Attempts have also been made to determine experimentally the effect of rain and mist upon the trajectory, but with little success thus far. According to foreign estimations, this effect may be as great as that of four per cent change in air density.

The field is still open for mathematical research in yaw and drift and in other problems of exterior ballistics. In particular it is important to obtain a retardation law which can be applied to modern projectiles. Firings could be conducted using projectiles of good shape and stability, and the results reduced so as to be applicable to any projectile. If from theory alone, it were possible to

construct a workable range table, retardation firing should be made even if they are expensive, for the cost of range firing several large caliber guns would not be greater than the cost of a retardation law investigation.

Major Hull and Dr. Eckhardt of the Bureau of Standards have developed a solenoid chronograph with which it is hoped to be able to measure velocities very accurately, so that an accurate resistance law may be obtained from velocity firings using this chronograph. In such an experiment the greatest difficulty would arise from the necessity for measuring the velocities to an accuracy sufficient to give consistent results. Experiments are now going on at the Proving Ground in an attempt to determine a new retardation law using this chronograph. The English believe that the present air resistance laws are so poor that no new ballistic tables should be computed until a better law has been determined.

The French and English have obtained considerable information from investigating the forces on a projectile, which was held in a tunnel through which air was passing at high velocity. Under the direction of Major G. F. Hull wind tunnel experiments have been carried on in this country and thus far the results agree that the retardation law depends on the shape of the projectile, that it is of the form $R=V^2f(v/c)$ where c is the velocity of sound; that boat tailing decreases resistance and that ogvial heads appear to offer less resistance than conical heads. Blunt pointed projectiles were found to be so poor that refinements of boat-tailing, and so forth, were unable to reduce the resistance very much. (See Army Ordnance, Vol. I, No. 6, "The Experimental Determination of the Forces on a Projectile" by G. F. Hull)

In the process of investigating all of the factors which affect the flight of projectiles, the English have also made a study of the effect of the yaw and the precessional motion of modern projectiles. It was hoped to obtain information upon which a mathematical theory for computation of drift could be based. In addition, it was hoped to learn something about projectile stability effects on range and dispersion. They succeeded in setting up expressions for drift which approximated the experimental results but which were too cumbersome for general use. Capt. R. H. Kent has been following the lead of the British in this country and has set up at Aberdeen a 1000 foot range with jump cards placed at intervals, and from firings through these cards and examination of the holes, he expects to obtain a great deal of important information on the subject of the effects of initial yaw and precession on flight. He has already obtained some results which are interesting from the standpoint of projectile design. (See Army Ordnance, Vol. II, No. 10, "Projectile Design" by R. H. Kent.) He hopes to develop a rational system of projectile design, which will permit predicting the range and dispersion of a projectile from consideration of the mechanical properties of the projectile and gun in which it is to be fired.

The principal elements entering into the ballistic design of projectiles are: weight, shape of ogive, shape of base, position of center of gravity, ratio of the two principal moments of inertia, position and shape of rotatng band, and position of the bourrelet. During the war each of these questions was gone into in considerable detail. False ogives were developed to give an increase of from 10 per cent to 25 per cent, in the maximum range. Flanged false ogives and ogives with a meplat have been tried out, but on the whole, purely conical or ogivel heads appear to be best. From the artilleryman's point of view, simplification in the number of types of projectiles for each gun is desirable, and this may be accomplished in the future by the adoption of suitable false ogives.

Modifications of the base by boat-tailing and by attaching a boat-tailed false base have been investigated. A boat-tail of about 7½ degrees has been found to be advantageous for a great many of our projectiles. Too much boat-tail has been found to be worse than none at all. But it cannot be said that a best angle of boat-tail for all projectiles exists. Wind tunnel experiments indicate that the best angle of boat-tail depends on all of the other characteristics of the projectile. Photographs show that with modern shell, most of the resistance to a projectile occurs at the rear end. It has been found in a rather rough test on a 4.7″ shell, that the addition of a boat-tailed false base increased the range and decreased the dispersion appreciably at maximum range. (See C. A. JOURNAL, Vol. 53, No. 4, "Projectiles," by Major W. P. Boatwright, C. A. C.)

Poor design of pre-war rotating bands, causing unsteadiness in flight and increase in resistance, has led to investigations which were carried out with the aim of eliminating the bad effects of the bands. Notably in the case of the 6-inch shell, it was found that the flaring of the band, on account of the lip, caused a decrease of 25 percent in range and a decrease of several hundred percent in accuracy, at maximum range. It has been found that copper rotating bands do not have sufficient shearing strength for use in extremely high power, high velocity guns, and it is possible that if such guns are introduced, rifled projectiles will ultimately be used with them.

Our pre-war method of rifling guns was to use an increasing twist, but the European nations have obtained better results with uniform twist, and some of our own experiments have verified this. In the future it is probable that American guns will have uniform twist of rifling. The effect of rifling, including the number of grooves, depth and width, and the effect of worn rifling on the amount of rotation, band engraving, yaw, and so forth, have been investigated and discussed by Major Veblen and Lt. Alger. (See C. A. JOURNAL, Vol. 51, No. 4, "Rotating Bands," by Major O. Veblen and Lt. P. L. Alger.)

A small arms range has been set up at Aberdeen and many investigations of the rifle and machine gun are being undertaken. The Joly microphone chronograph is being used to measure velocities; the trajectory is being determined by firings into paper screens placed at points along the path of the projectile, and improved types of projectiles are being designed.

The importance of accuracy of fire and development of projectile design is becoming greater because much fire is now indirect, some of it at rather high angles of elevation. Instead of obtaining a chance scattering of shots on the target, artillerymen desire to have projectiles which will give a very small dispersion, and with which the desired scattering of shots can be obtained by changing the elevation slightly. The paradoxical opinion has sometimes been expressed that when the dispersion is small the chance of hitting the target is small, but such opinions are disappearing with the introduction of scientific methods which are avoiding as many as possible of the ghosts which prevent accurate firing. What is needed is a projectile that will be as accurate as possible at the battle range. It is possible that a projectile which is more accurate than another one at extreme range, is relatively less accurate at battle range. But this is not believed to be the case. The extreme battle range, where the number of hits for a given expenditure of ammunition becomes negligible depends on the accuracy of the weapon. The question is therefore partly an economic one. For maximum efficiency it would appear that such a range should be chosen as to use most of the power of the gun, at the same time choosing an elevation where the number of rounds per hit is the smallest. It is interesting to note that at an

elevation of 15° to 20° where about two-thirds of the maximum range is usually obtained, the dispersion is relatively least. It therefore appears that this is one region for efficient firing.

The term "accuracy of a gun" is inexact in that the dispersion in range—which measures the so-called accuracy of the gun—is dependent on both projectiles and gun, and since the design of the bores of guns has been brought much nearer to maximum perfection than has the design of projectiles, the accuracy of the projectile is of supreme importance. Designs of projectiles are sometimes such that if a new design gives an increase in range it does not also keep the dispersion low, but gives a more than proportionate increase in dispersion. For well designed projectiles and twist of rifling of gun, both range and dispersion should improve simultaneously. The possibility of obtaining a shell which is too stable should be avoided; the best conditions are probably found in obtaining the best value of the stability consistent with a minimum of rotation.

The importance of firing a large number of rounds in a short interval of time is being realized in the process of determining the proving ground probable error. However, variations in wind and in other meteorological conditions from moment to moment, are sufficient to change the range in such a way as to make an exact theory of dispersion impossible, because it is not possible to take these variations into account. Owing to poor determination of proving ground probable error and to the additional personnel and instrumental errors introduced in the field, it is advisable to multiply the proving ground probable error by a safety factor of at least 1.5 before using it.

English mirror and window position finders were introduced at Aberdeen for use in antiaircraft burst observation, for it had been found that ordinary sights were not well adapted to this work. Window position finders may also be used for observing splashes of firing at low elevations. (See COAST ARTILLERY JOURNAL Vol. 53, No. 6, "Mirror and Window Position Finders," by Lieut. W. C. Graustein.) However, antiaircraft gunnery and range tables have not yet been developed satisfactorily. Empirical and approximate formulae based on French guns and range tables are still being used. Investigations are now being made to improve this condition.

Interior ballistics has been very much neglected in this country. Laboratory investigations including closed chamber experiments would be very much worth while. There is a very large field for investigation in this subject, since there is practically no good fundamental experimental basis upon which an accurate mathematical theory can be based. However, Captain A. A. Bennett has recently prepared a set of interior ballistics tables which simplifies interior ballistics computations. See "Tables for Interior Ballistics," Ordnance Department, Doc. No. 2039 by A. A. Bennett. Experiments are now being carried on at the proving ground to determine the accuracy of present methods of computing and measuring pressures in guns; pressures are measured simultaneously by ordinary plug gauge, Curtis spring gauge, Piezo electric gauge and by computation on the basis of the measured velocity of free recoil.

The names of some of the men who played important parts in the development of ballistics during the war, and from whose reports most of the foregoing material was obtained are: Alexander, Alger, Bennett, Bliss, Carmichael, Galajikian, Graustein, Gronwall, Hull, Kent, Loomis, Mitchell, Moulton, Ritt and Veblen. Most of these men were emergency officers of the Ordnance Department during the War.

For those who wish to pursue this subject in greater detail, the following references are recommended:

TITLE	AUTHOR
Introduction to Ballistics	Ordnance Department (Capt. A. A. Bennett)
Tables for Interior Ballistics	Ord. Dept. Doc. No. 2039 (Capt. A. A. Bennett)
Meteorology for Coast Artillery	1st Lieut. J. J. Johnson
A course in Exterior Ballistics	Ord. Dept. Doc. No. 1051 (Capt. Roger Sherman Hoar)
Numerical Integration of Differential Equations.	C. A. JOURNAL, Vol. 51, No. 1 (Major F. R. Moulton)
The Method of Numerical Integration in Exterior Ballistics	Ord. Dept. Doc. No. 984 (Capt. Dunham Jackson)
The Equations of Motion for Interior Ballistics	Ord. Dept. Technical Notes No. 1 (G. P. St. Clair)
A. L. V. F. Ballistic Tables	Ord. Dept. Doc. No. 983
Artillery Circular M. (Revised 1917)	Ordnance Board (Col. J. M. Ingalls)

A Brief History of the 52nd Coast Artillery (Railway)

By MAJOR W. W. HICKS, *C. A. C.*

The genealogy of the present 52nd Coast Artillery goes back to the time of the American Revolutionary War, but the first definite status given to artillery as a unit was when those colonial troops who had served during the War of Independence were reorganized into the First Battalion of American Artillery.

From this vague, slender beginning, we can trace the growth of this great organization through an uninterrupted and glorious service in all of our wars, including that with England in 1812, the Florida War in 1835, the Mexican War of 1845, the Civil War from 1861-1865, the Spanish-American War of 1898 and many other campaigns of minor importance. In every conflict the artillery gained renown and made impressive records for gallant patriotism and loyal service; glorious are the traditions and great the prestige of the 52nd Artillery's progenitors.

The First Battalion of American Artillery was merged with the Engineers in 1794 and became known as the Corps of Artillerists and Engineers. To them was assigned the defense of ports and seacoast. This combined corps was separated into two distinct branches in 1802, the artillery troops forming the First Artillery Corps still primarily coast artillery. In 1814 the First Artillery Corps was reorganized and formed the First, Second, Third and Fourth Artillery. The present 52nd Artillery is a descendant of the 1st and 2nd Artilleries.

Congress, in 1901, passed an act which provided for 126 companies of coast artillery and to supply the necessary nucleus of seasoned troops for these companies, the artillery was again reorganized. This was the beginning of the present Coast Artillery Corps.

On the 6th of July, 1917, just three months after America's entrance into the World War, the First Coast Artillery Expeditionary Brigade was formed at Fort Adams, Rhode Island. The regiments of this brigade were formed from coast artillery companies from various posts and were three in number, the 6th, 7th and 8th Regiment, C. A. C., completing the brigade. The 7th Regiment, C. A. C., was commanded by Colonel Johnson Hagood, who took the regiment overseas and remained in command until a well-earned promotion relieved him.

After a period of extensive preparation and intensive training the 7th Regiment, C. A. C. left Fort Adams, R. I., on the 17th of August, 1917, and the next day, the 18th of August, 1917, embarked on the Cunard liner *Aurania*, which sailed at 2:00 P. M. the same date. Halifax, Nova Scotia, was the first stop of the *Aurania*, and here she was joined by five other ships, forming a convoy which left Halifax on the 21st of August. When close to the coast of Ireland an escort of nine British destroyers met the convoy and reported enemy submarines in the vicinity. The convoy sought shelter in Bantry Bay, Ireland, while the British destroyers cleared the surrounding waters and enabled the convoy to proceed on its way within twenty-four hours. On September 1, 1917, the 7th Regiment, C. A. C., landed in Liverpool, England, and boarded train for Camp Oxney, Aldershot, England, from which place, after seven days' training, the regiment entrained for the port of Southampton.

On the 10th of September the regiment boarded the channel steamer *La Marguerite* and docked at 3:00 A. M. on the 11th in the port of LaHavre, France. The regiment spent twenty-four hours in a British rest camp just outside of LaHavre and on the morning of the 12th entrained for Mailly-le-Camp, which place was reached on the 13th. Intensive training was again taken up in Mailly-le-Camp until the 22nd of September, when the regiment was ordered to begin the construction of an artillery camp at Haussimont, which place at that time was nothing but a barren field, boasting neither house nor billet of any description. From this humble start grew a camp which, at the signing of the armistice, could accommodate 10,000 men.

On the 5th of February, 1918, the designation of the regiment was changed from the 7th Regiment, C. A. C., to the 52nd Artillery, C. A. C., which numerical designation it still bears.

It is a source of great pride to the 52nd Artillery that it was amongst the first fifty thousand to reach France and that it was immediately put into that region afterwards noted for the deeds of valorous American troops. Long before America had gathered her forces to such an extent that she could take over her own sector the 52nd Artillery was familiar with that terrain from frequent journeys over it, sometimes fighting, sometimes working, but ever doing their best towards the defeat of the enemy.

The first time the enemy experienced the accuracy of the heavy artillery manned by Americans was when Batteries "L" and "M" of the 52nd went into position in the Champagne sector and opened fire. This was on the 13th of February, 1918, and by the 16th of February the battalion had withdrawn, having attained its objective.

On the 6th of August, 1918, the regiment was reorganized again, following a new table of organization which left it with three battalions of two batteries each. Each battalion was equipped with four guns, two to each battery, and one or more of these battalions was in every major engagement which took place after the American Army was in line. The guns which the regiment manned were railway mounts, 320 millimeters caliber and threw a shell weighing over 750

pounds. The guns formerly belonged to the artillery of France and when hostilities ceased the guns were returned to the French. Part of the time the regiment served with French troops, but were with the Americans when they crashed through the line at St. Mihiel and the Meuse-Argonne; they were not assigned to any particular army or division permanently, but were called to whatever place their smashing force was most needed.

The 1st Battalion of the 52nd consisting of Batteries "A" and "B", had their first actual engagement on the 27th of August, 1918, when they opened fire on enemy batteries from the outskirts of shell-torn Verdun. On the 29th the battalion moved to Baileycourt and again delivered effective fire upon the enemy. The French provided excellent airplane observation and in consequence it was possible to destroy a most important German O. P. In both of these instances the battalion had been "loaned" to the Fourth French Army and acted under the orders of its Army commander. September 11th found the battalion in position for the St. Mihiel offensive, in which it played an active part, delivering effective fire on Saint-Maurice-sous-le-Cote, a most important town on the German line of communications. Although no observation of fire was possible the guns were so accurately laid that during the entire period of the engagement neither railway trains, troops nor ammunition trains were able to pass through the town. In view of the fact that one of the few good roads leading to the western frontier of the St. Mihiel sector passed through Saint-Maurice-sous-le-Cote, the effective fire of the 1st Battalion was of inestimable value in the gaining of the St. Mihiel victory. The 13-inch shells dropping into this town at irregular intervals of time varying from one to ten minutes, not only completely destroyed many of the stone buildings and blocked the roads, but in addition blew up a large German ammunition dump in its outskirts.

On the 25th of September the battalion assisted in the drive on Mont Faucon from a position near Rampont. On the 26th it was in place for the Meuse-Argonne offensive and helped to blast the enemy from the territory he had held for four years. The battalion kept up a steady fire for twenty-four hours during this offensive, the while being subjected to severe counter-battery fire from the enemy's heavy guns.

Batteries "C" and "D", the 2nd Battalion of the regiment, did not get an opportunity to prove their mettle until the St. Mihiel offensive, being engaged in the less romantic but equally necessary work of constructing ammunition dumps and railroads. In September the battalion was ordered from the Toul sector, where it had been engaged in constructing a much-needed stretch of railroad, to a position near Roymeux and by the 5th of September was in readiness for the drive. The battalion remained in the vicinity of Roymeux until September 15th, and from this point hurled many shells on the enemy's stronghold although under severe counter-battery fire most of the time themselves.

On the 22nd of September the battalion moved to a position near Fort Belrupt and from this point fired upon, and totally destroyed an ammunition dump. By the 26th of September the battlion was in line for the Meuse-Argonne offensive and aided in driving the foe from his well-established line of defense in spite of the enemy's determined counter-battery fire. In October the battalion moved to the Argonne sector and there constructed railroad gun positions, or "epis" as they are technically termed. While engaged in this work the battalion was often subjected to the enemy's fire and gas attacks, but worked right through it all until the armistice brought peace and orders to proceed to Haussimont preparatory for sailing orders.

The 3d Battalion, Batteries "E" and "F", were one of the first battalions of heavy artillery to get into action, their debut in the theatre of war taking place on the 13th of February, 1918, in the Somme-Suippes Defensive. On May 3rd the battalion was ordered to the Champagne front, where the enemy was again given a practical demonstration of the accuracy of the American artillery.

Early July found the battalion on the Aisne-Marne front and from the 15th to the 18th it was engaged in the Aisne-Marne defensive, during which defensive it was subjected to severe fire from the heavy guns of the enemy, the "strafing" lasting for seventeen hours.

Later in the same month, July, the battalion was recalled to the Champagne front and remained there until September 25th, when it was ordered in to the Meuse-Argonne region. It took part in the great offensives enacted in the Meuse-Argonne region and remained there until relieved in October.

The 1st, 2nd and 3rd Battalions of the 52nd Artillery (S. A. C.) hurled high explosive shell amounting to almost two million pounds on the enemy's territory before the armistice was signed, and every ounce did its share in silencing the enemy batteries, tearing up the roads and hindering the supply service, dislodging the enemy from vantage points that were impregnable to everything save the ponderous shells thrown by the 52nd Artillery's guns and those of like caliber.

It was under far different circumstances that the 52nd Artillery again viewed Haussimont; the first time it was a barren field, now it was a well equipped, modern camp; they had seen it when the roar of enemy guns filled the air and hostile airplanes circled overhead and dropped their death-dealing bombs, and they saw it in peace. And in peace they left it on the 2nd of December, 1918, when they entrained for St. Nazaire, which port they reached on December 4th. On the 22nd of December, 1918, the regiment sailed from St. Nazaire and it is symbolical that the vessel which carried them was a former German mail boat but now the U. S. S. *Antigone*. On the 3rd of January, 1919, the *Antigone* docked at Newport News, Virginia. The regiment again set foot on U. S. soil and marched to Camp Stuart, Virginia, where they rested until the 5th, on which date all boarded train for Camp Eustis, Virginia, the camp at which the regiment is now stationed.

Indoor Target Practice Apparatus

By Lieutenant F. J. Leerburger, *C. A. C., O. R. C.*

The coordinated training of battery personnel during the winter months, under conditions which will exist during target practice, has long been felt to be of vital importance. The difficulties of instruction are many, but an outstanding one is the fact that in assigning men to the regular positions in the system, the Battery Commander cannot watch every detail simultaneously and cannot always demonstrate the entire machinery to the men, together with their places in it. The only solution that will give the Battery Commander the necessary close supervision, is some kind of method which will allow all the personnel to be assembled in one room and to perform their functions in the presence of each other. The puff board described in Bulletin No. 250-RI. October, 1918, C. A. School, was an attempt to reproduce in miniature the problems of the field. The puff Board, while of service in firing against fixed targets, fails to give any assistance in the training of personnel in firing against moving targets. The War Game was somewhat more successful in accomplishing the desired training, but the puff arrangement cannot be used in connection with it.

In view of the fact that many poor target practices are the result of insufficiently trained observers, readers, plotters and spotting section personnel, it seems that the use of apparatus which is capable of simulating actual target practice conditions, while at the same time being inexpensive and simple to build, would be of great value to those charged with the firing of batteries against moving targets. At one post one of the B. Cs. has arranged a fan motor to move a miniature ship across the squad room, and has placed his entire range section at work in tracking and plotting its course. The system, however, fails to give practice in plotting curved courses or those of irregular speed, or to simulate the splashes which would train the spotting section and give the Battery Commander practice in adjustment.

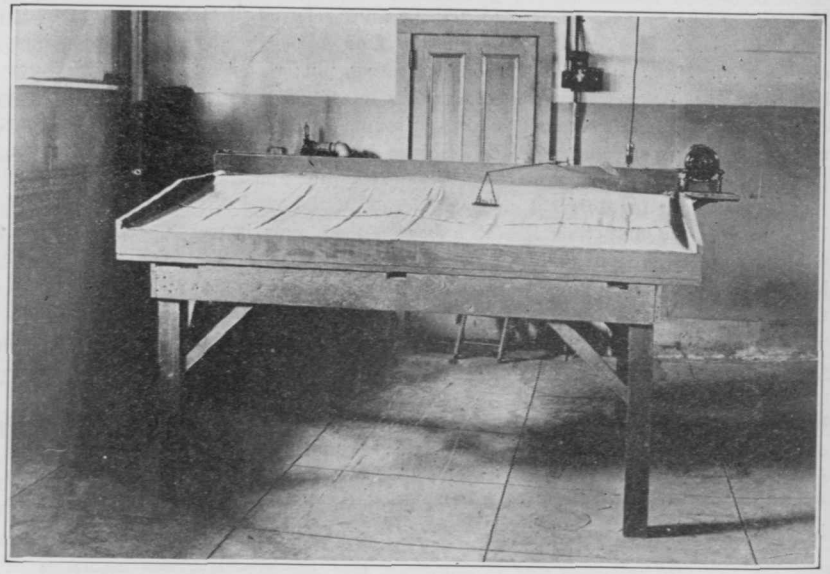


FIG. 1

The apparatus described here was developed at Columbia University in connection with the R. O. T. C. unit. The problem was to introduce to the students, who had been studying the theory of firing, the practical operation of the fire control system. To do this it was necessary for them to see the workings of the machine from a bird's-eye view. The puff board described in the publication mentioned above was part of the equipment of the R. O. T. C. unit. The indoor target practice apparatus was developed and built with the puff board as the foundation. It consists of the puff board, the field of which is covered with cheese cloth; attached to the rear of the board is an apparatus which causes a miniature battleship to move across the field in a straight or curved path, at the same time permitting a puff (or a splash) to be placed at a predetermined distance from the ship at a given moment. Observing and spotting instruments may be set out in front of the field at convenient distances; plotting boards, spotting boards and all range correction apparatus assembled in the same room, and work could be carried on under conditions actually simulating those encountered in service practice. A threaded drive shaft was suspended in hangers at either end

of the board and at its rear. A small electric motor controlled by rheostat and reversing switch rotated the drive shaft through a worm and wheel arrangement. A threaded block was attached to the drive shaft, and was kept from rotating with the shaft by two guide strips passing on either side of a flat guide bar underneath the shaft. When the motor revolves and rotates the shaft, the carrier block has longitudinal motion impressed on it. A block was pivoted to the upper surface of the carrier. A guide and fitted block similar to the carrier and block, but lighter in construction, was placed on a guide shaft to the rear of the drive shaft and was free to slide. A light rod passed through both pivoted blocks and supported the silhouette of a ship at its outer end. By various wing nuts and clamp screws on the guide and carrier, the silhouette could be given either

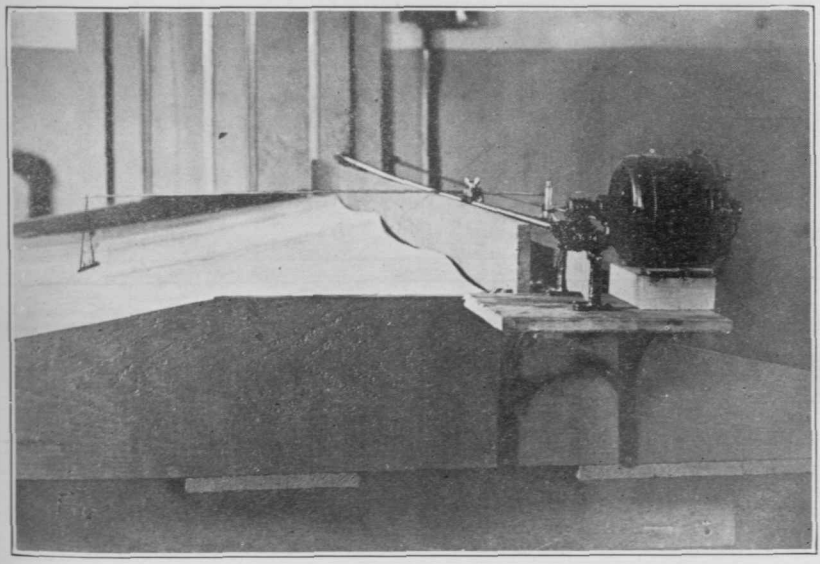


FIG. 2

straight line or curved motion. The motor speed, gear ratio, and pitch of the drive shaft were calculated so as to give the ship the proper speed to simulate a real ship at about 15,000 yards range. In the use of the apparatus constructed at Columbia University, the azimuth instruments were set about ten feet from the front of the puff board. It was then discovered that the telescopes of the instruments could not be focussed on the ship because of its proximity to the objectives. Ordinary eyeglass lenses of .25 diopters were attached to the frames and clipped over the objectives, and the instruments could then be sharply focussed. A pantagraph, as described in the puff board equipment, together with a small electric light and hydrochloric acid ammonium hydroxide puff arrangement were set up under the cloth representing the sea. The control end of the pantagraph was a map in reduced size of the map on the plotting board. The plotter and range section would function in their usual way and by a system of numbers would indicate where the shot was to be aimed. The pantagraph operator would set the apparatus at the indicated spot, correcting same for dispersion of the shot by drawing a number from a dispersion bag, and press the puff bulb at the

proper time. The spotting detail would then pick up the splash and function as in practice.

A few mechanical difficulties were encountered when first constructing the apparatus. These were easily disposed of, however, and everything functioned according to the expectations of the builders. One difficulty met with was the bending of the shaft because of its excessive length between the hangers. This was overcome by replacing the shaft with one of greater diameter and by putting ball bearings on the flat guide shaft underneath to support the weight of the carrier.

Figure 1 shows the puff board with cheese cloth simulating the sea. The 1/10 horsepower motor at the right, in front of which are two shaft hangers, and

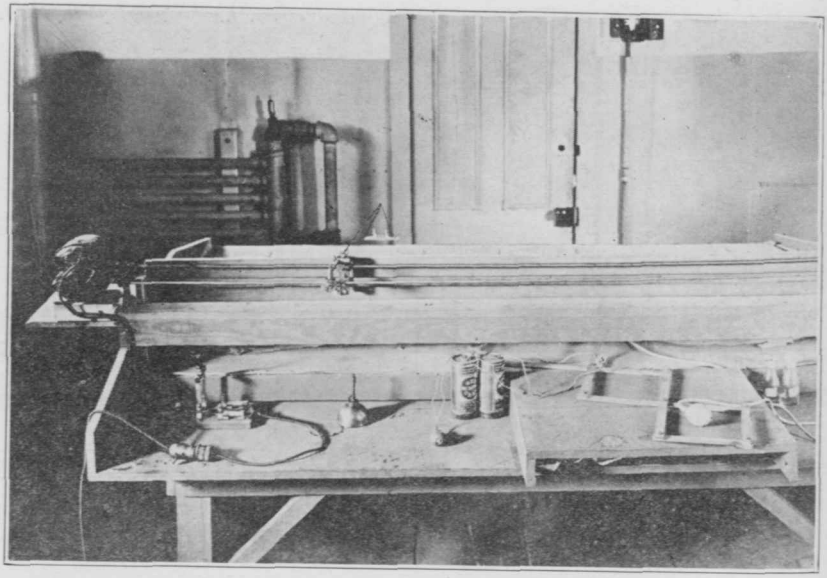


FIG. 3

about one-third of the board length to the left are the guide and carrier in which is suspended the rod supporting the ship seen in the foreground. The puff arrangement is free to move underneath the cheese cloth.

Figure 2 is the right-end view of the apparatus, showing the motor, worm gear, and worm wheel geared to the drive shaft, in rear of which is the guide shaft. The carrier and rear guide are shown in their respective positions on the drive shaft and the guide shaft. The ship rod is shown supporting the ship and passing through the carrier swivel block and guide swivel block.

Figure 3 shows the rear of the apparatus with the motor at the left of the drive shaft, below which is the guide bar and in rear of which is the guide shaft. The double-throw, double pole switch is used for reversing the motor at the end of the course. The batteries and push button are used to light a small bulb on the end of the pantagraph. The rubber bulb is used to force the ammonium hydroxide over into the hydrochloric acid bottle and cause the puff. To the board underneath the control end of the pantagraph is fastened a cross section sheet or a cross section map of the area.

Figure 4 shows the rear guide at the left and the carrier and carrier guide at the right. The wheel on the rear guide is used to fasten the guide block to the guide shaft. The wing nut underneath the guide block fastens the swivel block to the guide block. The thumb screw on the top of the swivel block fastens the ship rod. The wing nut on the carrier swivel block fastens the swivel block to the carrier block. The drive shaft passes through the carrier block and is threaded to it. The strips on either side of the carrier block are the carrier block guide and pass down on either side of the guide bar. The clearance between the guide and the bar is taken up by two round-headed adjustment screws, one of which is shown projecting out with a lock nut on the surface of one of the

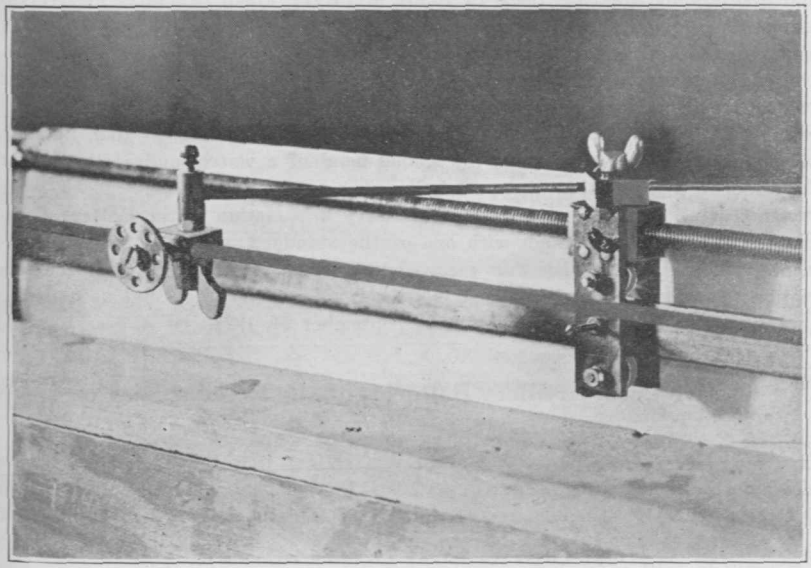


Fig. 4

guide strips. Two small bearing races are fastened between the guide strips and bear on the upper and lower edges of the guide bar.

The form of the ship's path is controlled by the various nuts and screws on the rear guide and carrier. Assume that it is desired to have the ship track a straight course 16 inches from rear guide. The rear guide wheel is loosened, as is the rear guide thumb screw and carrier wing nut. The rear guide is slid along the rear guide shaft till the guide is directly in rear of the carrier, when the carrier wing nut is fastened. The ship rod is slid back till the distance from the rear guide swivel to the ship is 16 inches. Then the rear guide thumb screw and wing nut are clamped tight. The guide wheel is left unclamped and the apparatus is ready to track. Suppose, on the other hand, that it is desired to have the ship track a curved course of radius 20 inches. The guide is moved to the rear of the carrier in the same manner as before. The ship rod is pulled forward until the distance from thumb screw to ship is 20 inches. The thumb screw is then fastened. The guide wheel is tightly clamped, while the wing nuts of the guide and carrier are left loose. The apparatus is now ready to track.

The construction was completed in about three weeks, which included the experimental period. The cost of the material totaled $45. The apparatus was used to track one course, and before it could be used to demonstrate simulation of actual target practice conditions the final examinations were at hand, and the summer vacation followed. Further experimenting was curtailed by the abolishing of the R. O. T. C. unit by the Government. The puff board was disposed of as directed by the Depot Ordnance Office.

This article is submitted in the hope that some apparatus similar to the one mentioned here will be constructed and used as a means to improve the training and knowledge of the personnel, at the same time giving an added interest to indoor work. The apparatus will facilitate the training of readers and observers and spotters by allowing them to follow a target which simulates closely the maneuvering of an actual target, both as to speed and course. The plotter sets his predicted and setforward points, and the pantagraph operator sets the control end of his instrument at the point corresponding to the plotter's setforward point. He then draws a number from the dispersion bag and moves the pantagraph off the setforward point by an amount corresponding to that number. When the bell rings he observes the second hand of a watch, and at the end of the time of flight pushes the puff bulb. The spotters pick the "splash"; the spotting detail plots it and gives the necessary information to the Battery Commander, who follows through with one of the standard methods of fire adjustment. The entire detail has thus received instruction. The operators of the correction apparatus function as usual and their data is recorded and used in the analysis of the drill. Dated New York, September 24, 1924.

Active Coast Artillery Batteries of the Regular Service

1st Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Cristobal, Fort DeLesseps, C. Z.
Batteries E and G ..... C. D. Cristobal, Fort Randolph, C. Z.

2nd Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Cristobal, Fort Sherman, C. Z.
Batteries E, G and H ..... C. D. Cristobal, Fort Sherman, C. Z.

3rd Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Los Angeles, Fort MacArthur, Cal.
Batteries A and B ..... C. D. Los Angeles, Fort MacArthur, Cal.
Battery D ..... C. D. San Diego, Fort Rosecrans, Cal.
Battery E ..... C. D. Columbia, Fort Stevens, Oregon

4th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Balboa, Fort Amador, C. Z.
Batteries A, C, D, G and I ..... C. D. Balboa, Fort Amador, C. Z.

5th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Southern N. Y., Fort Hamilton, N. Y.

6th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. of San Francisco, Fort Winfield Scott, Cal.
Batteries A, E and K ..... C. D. of San Francisco, Fort Winfield Scott, Cal.

7th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Sandy Hook, Fort Hancock, N. J.
Batteries A, B and D ..... C. D. Sandy Hook, Fort Hancock, N. J.
Battery E ..... C. D. Delaware, Fort DuPont, Del.

8th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Portland, Fort Preble, Maine
Battery E ..... C. D. Portsmouth, Fort Constitution, N. H.

9th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Boston, Fort Banks, Mass.
Battery A ..... C. D. Boston, Fort Banks, Mass.
Battery C ..... C. D. Boston, Fort Duvall, Mass.

10th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Narragansett Bay, Fort Adams, R. I.
Battery E ..... C. D. New Bedford, Fort Rodman, Mass.

11th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Long Island Sound, Fort H. G. Wright, N. Y.
Batteries G, H, I and K ..... C. D. Long Island Sound, Fort H. G. Wright, N. Y.

12th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Chesapeake Bay, Fort Monroe, Va.
Batteries A, B and C ..... C. D. Chesapeake Bay, Fort Monroe, Va.
Battery D. ..... C. D. Baltimore, Fort Howard, Md.
Battery E ..... C. D. Potomac, Fort Washington, Md.

13th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Pensacola, Fort Barrancas, Fla.
Battery A ..... C. D. Pensacola, Fort Barrancas, Fla.
Battery B ..... C. D. Pensacola, Fort Pickens, Fla.
Battery D ..... C. D. Charleston, Fort Moultrie, S. C.
Battery E ..... C. D. Key West, Key West Barracks, Fla.
Battery G ..... C. D. Galveston, Fort Crockett, Texas

14th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Puget Sound, Fort Worden, Wash.
Batteries A and G ..... C. D. Puget Sound, Fort Worden, Wash.
Battery D ..... C. D. Puget Sound, Fort Casey, Wash.

15th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Pearl Harbor, Fort Kamehameha, H. T.
Batteries A, B and C ..... C. D. Pearl Harbor, Fort Kamehameha, H. T.

16th Coast Artillery (Harbor Defense)

Headquarters Battery ..... C. D. Honolulu, Fort DuRussey, H. T.
Battery A ..... C. D. Honolulu, Fort DuRussey, H. T.
Battery C ..... C. D. Honolulu, Fort Ruger, H. T.

41st Coast Artillery (Railway)

Headquarters Battery ..... C. D. Pearl Harbor, Fort Kamehameha, H. T.
Batteries A and B ..... C. D. Pearl Harbor, Fort Kamehameha, H. T.

51st Coast Artillery (Heavy Tractor)

Headquarters Battery	Fort Eustis, Va.
Service Battery	Fort Eustis, Va.
Hq. Det. and C. Tn., 1st Bn.	Fort Eustis, Va.
Batteries A and B	Fort Eustis, Va.

52nd Coast Artillery (Railway)

Headquarters Battery	Fort Eustis, Va.
Service Battery	Fort Eustis, Va.
Batteries C, D, E and F	Fort Eustis, Va.

55th Coast Artillery (Heavy Tractor)

Headquarters Battery	C. D. Pearl Harbor, Fort Kamehameha, H. T.
Service Battery	C. D. Pearl Harbor, Fort Kamehameha, H. T.
Hq. Det. and C. Tn., 1st Bn.	Fort Shafter, H. T.
Batteries A, B and C	Fort Shafter, H. T.
Hq. Det. and C. Tn. 2nd Bn.	C. D. Honolulu, Fort Ruger, H. T.
Batteries D, E and F	C. D. Honolulu, Fort Ruger, H. T.
Hq. Det. and C. Tn., 3rd Bn.	C. D. Pearl Harbor, Fort Kamehameha, H. T.
Batteries G, H and I	C. D. Pearl Harbor, Fort Kamehameha, H. T.

59th Coast Artillery (Heavy Tractor)

Headquarters Battery	C. D. of M. & S. Bays, Fort Mills, P. I.
Batteries A, B, C, D, E, F and G	C. D. of M. & S. Bays, Fort Mills, P. I.

60th Coast Artillery (Antiaircraft)

Headquarters Battery	Fort McKinley, P. I.
Batteries A, B and C	Fort McKinley, P. I.

61st Coast Artillery (Antiaircraft)

Headquarters Battery	C. D. Chesapeake Bay, Fort Monroe, Va.
Batteries A, B and E	C. D. Chesapeake Bay, Fort Monroe, Va.

62nd Coast Artillery (Antiaircraft)

Headquarters Battery	Fort Totten, N. Y.
Service Battery	Fort Totten, N. Y.
Hq. Det. and C. Tn., 1st Bn.	Fort Totten, N. Y.
Hq Det. 2nd Bn.	Fort Totten, N. Y.
Batteries A, B, C, E and F	Fort Totten, N. Y.

63rd Coast Artillery (Antiaircraft)

Headquarters Battery	C. D. San Francisco, Fort Winfield Scott, Cal.
Batteries A, B and E	C. D. San Francisco, Fort Winfield Scott, Cal.

64th Coast Artillery (Antiaircraft)

Headquarters Battery	Fort Shafter, H. T.
Service Battery	Fort Shafter, H. T.
Hq. Det. and C. Tn., 1st Bn.	Fort Shafter, H. T.
Hq. Det., 2nd Bn.	Fort Shafter, H. T.
Batteries A, B, C, D, E, F, G and H	Fort Shafter, H. T.

65th Coast Artillery (Antiaircraft)

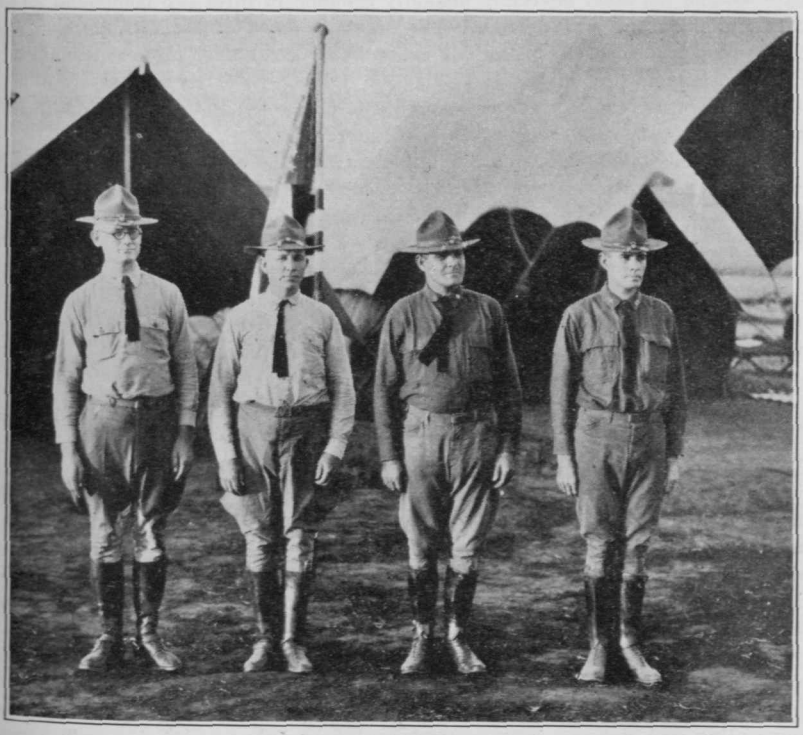
Headquarters Battery	C. D. Balboa, Fort Amador, C. Z.
Batteries A and B	C. D. Balboa, Fort Amador, C. Z.
Battery C	C. D. Cristobal, Fort Randolph, C. Z.
Battery D	C. D. Cristobal, Fort Sherman, C. Z.

91st Coast Artillery P. S. (Harbor Defense)

Headquarters Battery	C. D. M. & S. Bays, Fort Mills, P. I.
Batteries A, B, C and D	C. D. M. & S. Bays, Fort Mills, P. I.
Battery E	C. D. M. & S. Bays, Fort Hughes, P. I.
Battery F	C. D. M. & S. Bays, Fort Frank, P. I.
Battery G	C. D. M. & S. Bays, Fort Wint, P. I.

92nd Coast Artillery P. S. (Harbor Defense)

Headquarters Battery	C. D. M. & S. Bays, Fort Mills, P. I.
Batteries A, B, C, D, E and F	C. D. M. & S. Bays, Fort Mills, P. I.
1st Sound Ranging Battery	Fort Eustis, Va.



From left to right—Col. E. C. Robertson, Lieut. Col. C. S. Garrett, Major H. W. Irby and Capt. N. M. Irby, of the 206th Coast Artillery (A.A.)

How Dynamite Explodes

Big dynamite blasts are more and more frequent items of news, says Charles S. Hurber, writing in *Municipal and Country Engineering* (Indianapolis). Charges are buried deep in the face of a cliff an electric switch is turned, there is a deafening roar, and thousands of tons of rock come crashing down. What, the inquiring observer asks, produces this explosion? What actually happens when dynamite explodes? He continues:

To answer this question it is necessary to explain briefly what dynamite is. Reduced to its essentials, dynamite is a mixture of nitroglycerin with wood meal

and nitrate of soda or nitrate of ammonia, or both. Nitroglycerin, in turn, is composed of several different elements—namely, carbon, hydrogen, nitrogen and oxygen, the molecules of which are grouped in such a way as to form a heavy, oily, yellow liquid. Now these same molecules are capable of arrangement in other groups to form several different substances instead of one, and the bonds which hold them together in the particular arrangement which makes nitroglycerin are very weak.

Consequently, when the electric current sets off the detonator imbedded in the dynamite and this imparts a sharp shock and very high temperature to the nitroglycerin, the bonds between the molecules which compose the nitroglycerin break down. The nitrogen and some of the oxygen remain free—both of them gases—while the other molecules instantly combine to form two compound gases, carbon dioxide and water vapor. The breaking down of the nitroglycerin and the rearrangement of its molecules generates a great deal of heat—enough to raise the temperature of the gases to 6300 degrees F. or thereabouts—and this high temperature causes the other ingredients of the dynamite to decompose into gases, or to burn, with the release of still more heat.

All of this takes place in a single instant and the highly heated and rapidly expanding gases, which would normally occupy a much greater volume than the dynamite, exert a sudden tremendous pressure on the walls of the bore hole. The rock gives way and the escaping gases set the air into violent vibration. To the beholder, the explosion consists of the roaring noise and the rending of the rock, but in reality these are only the audible and visible results of the rearrangement of the molecules of the dynamite when subjected to a shock from the detonator, this conversion of the nitroglycerin and other ingredients of the dynamite into gases constituting the actual explosion.—*Literary Digest.*

Seacoast Fortifications

During the World War and the period immediately following, practically all of the defenses of the United States and its possessions became obsolete, due to developments in the range and power of artillery mounted on capital ships. Not only were these defenses underpowered in major armament, but defense against aircraft was either lacking, or totally inadequate. The only antiaircraft searchlights available were those purchased during the war, which were limited in number and in many cases unsuitable.

Due to the necessity for economy in government expenditures, the impossibility of emplacing armament at localities of secondary importance, at least for many years to come, was realized, and studies were undertaken with a view to augmenting such defenses with available railway artillery.

Of the railway artillery, the 14-inch .50-caliber Model 1920 gun is the only one which may be classed as major seacoast armament, and only a limited number of these guns will be available for several years to come. However, practically all available railway artillery will be of value in strengthening our coast defenses.

The effective use of mobile railway artillery depends primarily upon the capability of existing railroads to transport it. Fortunately, data collected and compiled up to this time, indicate that the more important units can be moved with comparative freedom throughout the United States, and can be installed in a short time at small cost. The selection of firing positions for railway artillery has been commenced at two localities, and will be continued throughout the United States as availability of funds permits.—*Annual Report of the Chief of Engineers.*

Supernatural Powers of Gas

Much has been said of new gases being discovered. Agitators and careless speakers refer to some of these gases in terms that indicate that they have supernatural powers. That is ridiculously erroneous. It is also seriously misleading. Chemicals have very definite limits to their power. * * *

Those who oppose any military establishments and would leave the nation defenseless, make use of exaggerated stories of the supposedly supernatural powers of gas. Their reasoning of course is fallacious. If gases had that supernatural power, every nation that would remain free would have to be a complete master of such substances and methods of using them.

Along with supernatural gases goes the continual talk of death rays, electrical currents and the like which will destroy all life at great distances. Practically all of these ideas are just as foolishly wrong as the supernatural gases. All known rays and power obey certain definite laws. Here and there advances are made in understanding those laws and directing them; but it is believed proper and safe to say that no real scientist can yet foresee the day when such control of these substances will be possible that life and machinery can be destroyed at anything but short distances—distances too short for any considerable use in war.

To keep abreast of all of these developments is the biggest object of the Chemical Warfare Service. It must be the instructor to the entire Army and Navy in the art of handling chemicals in war as no other organization is acquainted with them. It must teach the nation the peacetime uses of these substances since the nation itself does not know them. These things it has been doing. It teaches the Army through its Chemical Warfare School and instructors in other schools. It teaches them through training in Corps Areas under Corps Area Chemical Warfare officers; it teaches them by demonstrations by its own Chemical Warfare troops that were, in war, and must remain combat troops. It teaches the Nation at large by articles and interviews, by pictures and demonstrations and by making known to the public the results of all its investigations that are of use to the public.—*Extract from Annual Report of Chief of Chemical Warfare Service.*

The Army Communication Net

During the year, the Army Communication Net, involving over one hundred radio stations and certain leased lines, has been very advantageously used in the transmission of urgent communications heretofore sent over commercial telegraph lines. The operation of this net has provided effective means of training personnel, of preparing the Army for handling a nation-wide communication system in time of great emergency and has resulted in the saving of considerable sums of money. The service has been extended to the Veterans' Bureau and applications have been received from other Government Bureaus for similar service. Realizing that the operation of this net has been carried on by men, some of whom were yet in a training period, the efficiency has been remarkable and such irregularities as have occurred have been due to inadequate personnel, which has at times necessitated the utilization of operators not thoroughly trained.

The most important improvement in the Army Communication Net during the year was the installation of 10 KW Radio stations at Fort Douglas, Utah, and Fort Leavenworth, Kansas. These two remarkable stations represent the latest developments in the radio art. The stations are two important units in

transcontinental communication, will be of immense value in case of a national emergency, and are daily transmitting a heavy load of official traffic.

Looking into the future of signal communication for a moment, it appears that the basic method of breaking messages into words, words into letters, letters into dots and dashes, and then passing these through the wrist of an operator, as has been the practice since Morse's fundamental invention of the electric telegraph seems to be nearing the end of a cycle. Mechanical transmitters with higher speed qualities are becoming stabilized and American invention seems to be making further and rapid progress in associating photography with radio, which bids fair to revolutionize fundamental methods of transmission. The message of the future, whether it be written, printed, or mixed with diagrams and photographs, including the signature of the sender, will, it seems certain, soon be transmitted photographically by radio frequency at a rate of ten times faster than was ever possible by the dot and dash methods of hand transmission. Military messages of the future, particularly in active operations, may contain diagrams and sketches or even entire sheets of maps, all transmitted as part of the same message and by means of which the detection or listening in will be reduced to a very low minimum. The Signal Corps is keeping abreast of this progress and will undertake experiments to establish the military value of this invention. —*Extract from the Annual Report of the Chief Signal Officer of the Army.*

Civil and Commercial Aviation

There is today in the United States no commercial aviation deserving of the name, and the aeronautical manufacturing industry is unprepared to meet the demand for quantity production in the event of an emergency. It is true that a few aircraft operations continue in business but in rather a haphazard and unsystematic manner. It is also true that a limited number of producers have been able to survive the period of enforced idleness since the war. Nevertheless, we who gave the airplane to the world, who lead in nearly all phases of research and development and who hold nearly every important record in the air, trail far behind the commercial application of this new medium of transportation.

The reason for the unhealthy state of the industry is not difficult to discover. Government requirements for the Army, Navy and Post Office are alone insufficient to keep it alive and the demand for commercial and private purposes is practically non-existent. If our country is to assume its proper place in the world of aeronautics and thereby insure the development of an industry so essential to national defense, it must be through the creation of a commercial demand for aircraft.

At the present time there are four causes which restrain capital from entering the field of commercial aviation; the first is a fear of accidents with the consequent loss of life and property; the second is the high initial cost and rapid depreciation of equipment; the third is the impossibility of obtaining acceptable insurance rates and the fourth is the total lack of appropriate and uniform legislation covering the licensing of pilots and aircraft, defining the legal status of operators and providing for the establishment of landing fields and aids to air navigation.—*Annual Report of the Chief of Air Service.*

Actual Strength of the Army on June 30, 1924

The actual strength of the Army on June 30, 1924, by classes of personnel, was as follows:

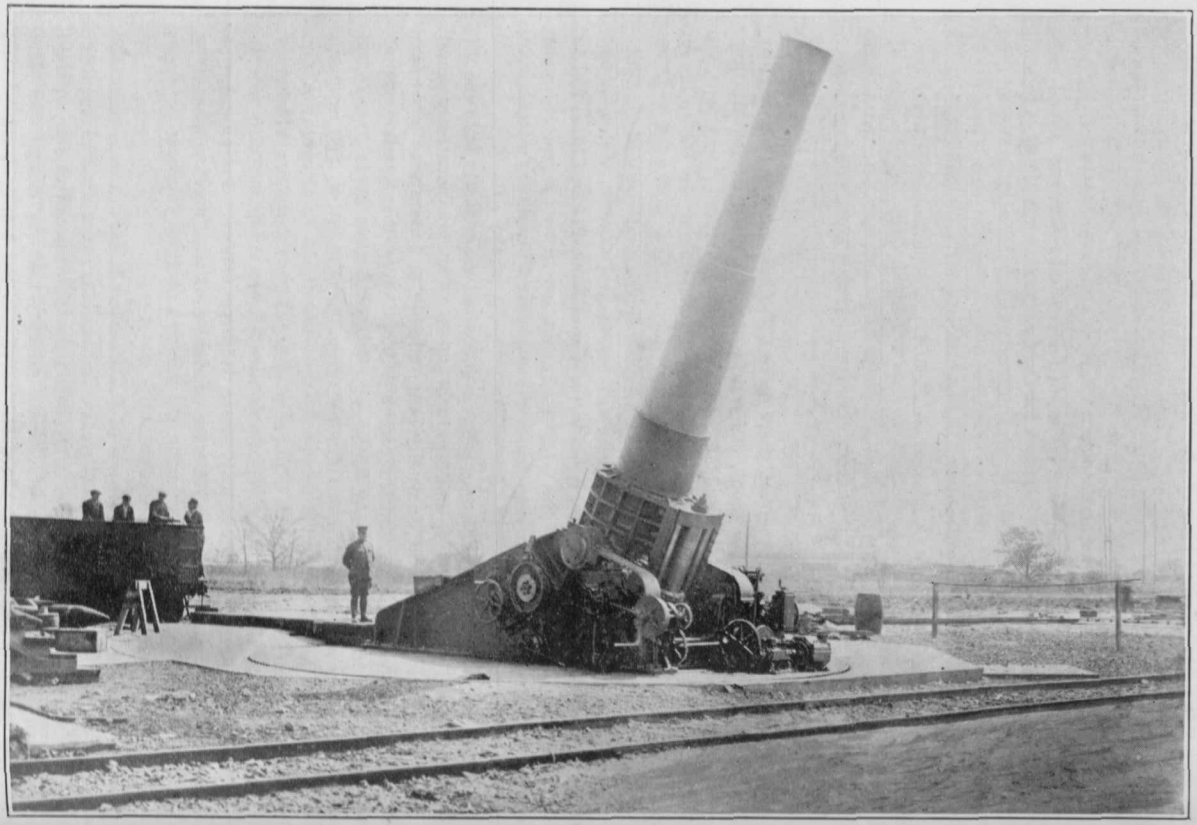
Commissioned Officers:	
Regular Army (active list)	11,335
Philippine Scouts (active list)	101
Retired Regular Army, on active duty	139
Retired Philippine Scouts, on active duty	17
Reserve, on active duty	61
Emergency (World War), undergoing treatment for physical reconstruction	2
Total commissioned officers	11,655
Warrant Officers:	
Regular Army (active list)	1,063
Retired Regular Army, on active duty	2
Total warrant officers	1,065
Enlisted Men:	
Regular Army (active list)	121,028
Philippine Scouts (active list)	7,115
Retired Regular Army, on active duty	80
Total enlisted men	128,223
Grand total	140,943

In addition to all of the foregoing, there were 675 Army nurses (468 regular and 207 reserve), 30 contract surgeons, 666 cadets at the United States Military Academy, 222 Army field clerks, and 167 field clerks, Quartermaster Corps, in service on June 30, 1924, making altogether 142,703 individuals in the military service of the United States on that date.

Of the 140,943 commissioned officers, warrant officers, and enlisted men accounted for above, 104,286 were serving in the continental United States, 13,096 in Hawaii, 11,808 in the Philippines, 8,880 in the Canal Zone, 977 in China, 392 in Alaska, 5 in Europe (attached to the Graves Registration Service), and 187 were either en route from one country to another or serving as military attaches in various foreign countries.

The strength of the Officers' Reserve Corps increased from 76,293 on June 30, 1923, to 81,706 on June 30, 1924, a net gain of 4,783. This comparatively small net gain is accounted for by the unusually large number of separations by reason of declination to accept reappointment upon expiration of the 5-year term of commission. During the fiscal year 21,065 appointments were made and 16,282 members of the corps were separated from service. Of the latter, 277 resigned, 1,246 were discharged, 210 died, 79 accepted appointments in the Regular Army, 13,793 were separated by reason of expiration of the 5-year term for which they were appointed, and the remaining 677 appointments were either declined or canceled. Of the officers appointed, 3,317 were Reserve Officers' Training Corps graduates of the class of 1924 and 348 were graduates of the "blue" course given at citizens' military training camps during the summer of 1923. During the fiscal year 6,838 reserve officers were placed on active duty.

During the same period the strength of the Enlisted Reserve Corps increased from 1,557 to 3,400. As in previous years, enlistments were limited to those qualified as noncommissioned officers and specialists to form cadres for units of the Organized Reserves, graduates of citizens' military training camps who were eligible and qualified and who did not desire service in the National Guard, and candidates for appointment as officers in the Regular Army or the Officers' Reserve Corps who would not otherwise be eligible for such appointment. During the fiscal year 141 enlisted reservists were called to active duty for 15 days' training.—*Extract from the Annual Report of the Adjutant General of the Army.*



16-INCH HOWITZER, MODEL 1920

Latest and most successful type of long range howitzer. *Length in calibers, 25; maximum elevation, 65°; minimum elevation*

COAST ARTILLERY BOARD NOTES

Communications relating to the development or improvement in methods or materiel for the Coast Artillery will be welcome from any member of the Corps or of the service at large. These communications, with models or drawings of devices proposed may be sent direct to the Coast Artillery Board, Fort Monroe, Virginia, and will receive careful consideration.—R. S. ABERNETHY, *Col., C. A. C., President Coast Artillery Board.*

New Projects Initiated During the Month of November

Project No. 304, Test of Fire Control Equipment for 155-mm. Guns.—In a letter dated October 7, 1924, the Chief of Coast Artillery recommended to the Adjutant General that the 51st, 55th and 59th Coast Artillery be directed to test certain fire control equipment for 155-mm. G. P. F.'s. This equipment was recommended by the Coast Artillery Board in Project No. 75, Fire Control Equipment for 155-mm. G. P. F.'s, published in the August, 1923, COAST ARTILLERY JOURNAL. Some of the listed equipment is to be furnished by local Ordnance officers and the balance by the Coast Artillery Board. Coast Artillery Board Project No. 304, Test of Fire Control Equipment for 155-mm. Guns, listed the equipment to be furnished by the Coast Artillery Board and discussed certain features of the test, particularly a solution of the deflection problem. Copies of this project have been furnished the Commanding Officers, 51st, 55th and 59th Coast Artillery Regiments.

Project No. 305, Comments on Training Regulations No. 435-280, "Gunnery."—Training Regulations No. 435-280, Gunnery, was transmitted by the Commanding General, 3rd Coast Artillery District, to the Coast Artillery Board. Members of the Board made a study of the training regulation and submitted comments thereon.

Project No. 306, Tactics of 16-inch Guns. (Charge to be used).—The 16-inch gun has been provided with three powder charges. It is therefore possible to hit a target at many ranges by use of any of two or three charges. In addition there exists a choice between fire at elevations above that for maximum range and elevations below it. The Coast Artillery Board made a study of the possibilities of fire with the three charges and recommended that the Ordnance Department furnish the latest and most accurate data available concerning the penetration in armor of 16-inch projectiles, and that the Coast Artillery Board be furnished with any information available in the Office of the Chief of Coast Artillery concerning the tactical handling of the 16-inch gun, in order that the Board may make a complete study of the charges which can be used and arrive at a decision.

Project No. 307, Proposed Modification of Antiaircraft Computer, Model 1917, for Case III Firing.—A study of the R. A. Corrector (A. A. Computer, Model 1917), was made by Frankford Arsenal relative to the possibility by simple modifications to make an instrument of a high degree of accuracy

suitable for Case III fire. The Coast Artillery Board made a study of the proposed modifications and made certain recommendations thereon.

Project No. 308, Time Interval Apparatus for Fixed and Mobile Artillery.—Is a comparative study of the several types of Time Interval Apparatus now being developed by the Signal Corps to determine their suitability for mobile artillery and to determine whether any types are suitable for fixed artillery.

Project No. 309, Test of Ford Battery and Target Computer.—The following fire control equipment has been ordered shipped from the Ordnance Officer, Coast Defenses of Cristobal, to Ordnance Officer, Coast Defenses of Chesapeake Bay, for test by the Coast Artillery Board:

1 Ford Fire Control Apparatus, complete, with accessory instruments, and two azimuth instruments, M1910, as follows:
1 Target Computer Mechanism without base.
I Base for Target Computer.
I Battery Computer without base.
1 Base for Battery Computer.
1 Pair Rheostats.
1 Spare parts box.
2 Demonstrating instruments.
2 Azimuth instruments, Model 1910, complete with pier mounts without tripods, with special worms and housings modified to receive Ford Transmitting devices, Nos. 77 and 375.

The above equipment will be tested by the Coast Artillery Board with a view to determining whether the device contains features which will be of value to the Coast Artillery Corps. Special attention will be given to the mechanism contained in one of the instruments designed to take the place of the Range Correction Board.

Project No. 310, International Code Flags.—In a letter dated November 4, 1924, from the Office of the Chief Signal Officer to the Chief of Coast Artillery, the Chief Signal Officer requested that his office be advised as to the size of International Code Flags, which should be issued to the Coast Defenses and recommended that if one set is to be issued, that No. 4 flag be furnished. This communication was referred to the Coast Artillery Board by 1st Indorsement, O. C. C. C. A., November 5, 1924, for remark and recommendation. The Coast Artillery Board recommended that No. 4 flag be issued to Coast Defenses for the reason that it is believed to be sufficiently large for all ordinary requirements and not so large as to be cumbersome.

Completed Projects

Project No. 227, Test of Cloke Plotting and Relocating Board.—

I—History of the Project.

1. One Cloke Plotting and Relocating Board No. 2, was shipped to the Ordnance Officer, Coast Defenses of Chesapeake Bay, for test by the Coast Artillery Board. In letter O. C. C. A., 413.6813/L-2, dated April 21, 1924, the Chief of Coast Artillery directed the Coast Artillery Board to test and report upon the Cloke Plotting and Relocating Board.

II—PROCEDURE.

2. The Coast Artillery Board arranged to turn the Cloke Plotting and Relocating Board over to the Commanding Officer, Battery Anderson, Fort Monroe, the Commanding Officer, 52d Artillery, C. A. C., and the Commanding Officer, 51st Artillery, C. A. C., in turn, for test under the supervision of the Coast Artillery Board.

III—DISCUSSION

3. *a.* The Cloke Plotting and Relocating Board was given a thorough test in both drill and service practice at Battery Anderson, Fort Monroe. As a result of this test the Coast Artillery Board made the following report to the Commanding Officer, Frankford Arsenal, Pa.:

> "2. During drills which preceded service practice it developed that the spring in the gun push button was too weak. During plotting the gun push button was used to obtain a mark on the paper-covered surface of the plotting board. Occasionally the point of the push button would stick in the paper with the result that when the platen was withdrawn the paper would become badly torn.
>
> "3. The defect was remedied locally. A small washer was inserted in the push button recess to increase the tension of the spring.
>
> "4. It is understood that 26 Cloke Boards will be made at Frankford Arsenal and that the construction program is not yet completed. It is suggested that stronger springs be used in the push buttons for gun position, master key and platen pivot."

In 1st Indorsement, F. A., 413.685/325, the Commanding Officer, Frankford Arsenal, made the following statements in reference to the above-mentioned defects:

> "1. The defects commented on in Par. 2 above have been noted. In this connection, information is furnished that the springs referred to have been increased slightly in strength and it is not believed that further difficulty will be experienced.
>
> "2. In view of the fact that the push buttons are made of steel and are hence liable to rust, it will probably be necessary to keep these parts sufficiently well oiled to guard against corrosion and the sticking, which would result."

b. The Cloke Plotting and Relocating Board, Model 1924, No. 2, was tested by Batteries "C" and "D", 52nd Artillery, C. A. C., who reported as follows:

> "2. *a.* The pointer in the center of the sliding box which is used in the offset method of plotting was not long enough to reach the paper. This defect could easily be corrected locally.
>
> *b.* The woodwork on the board was not up to the standard of the old Whistler-Hearn boards, the board having been warped slightly in places, making it hard to move the plotting arm.
>
> "3. The mechanical construction of the board, outside of the defects mentioned above, is excellent and a great improvement over the boards which have been in use here."

The Commanding Officer, 52nd Artillery, C. A. C. (Railway) made the following comment on the above report:

> "The defects mentioned in the foregoing are structural and can be remedied. I consider this new board entirely satisfactory."

c. The Cloke Plotting and Relocating Board, Model 1924, No. 2, was turned over to the 51st Artillery, C. A. C., (Tractor) Fort Eustis, Va., for test and the Commanding Officer of that organization stated that it was satisfactory.

IV—Conclusions

4. That subject to the correction of the defects mentioned in paragraphs 3*a* and b above, the Cloke Plotting and Relocating Board, Model 1924, No. 2, is satisfactory.

V—Recommendations.

5. It is recommended that Cloke Plotting and Relocating Boards, Model 1924, be issued to the Service, priority being given to mobile seacoast artillery units.

VI—Action by Chief of Coast Artillery.

Third Indorsement

War Department, O. C. C. A., November 5, 1924—To Chief of Ordnance:

"1. Herewith for your information are the proceedings of the Coast Artillery Board on Project No. 227, "Test of Cloke Plotting and Relocating Board.

"2. The remarks and recommendations contained therein are concurred in.

"3. A priority list has been furnished your office to cover the Cloke Board now under manufacture."

Project No. 248, Method of Adapting the Meteorological Message to the Wind Component Indicator.—

I—History of the Project.

1. It has come to the attention of the Coast Artillery Board that the practice followed in the Coast Artillery in the matter of stating the direction of the wind in the Meteorological Message is not uniform. In 3d Indorsement, Coast Artillery Board, April 15, 1924 (Project No. 221), the following statement was made: "The Air Service Meteorological Message provides for 72 points to the circle and zero north, and this system of units and azimuth origin would serve for Coast Artillery, although the south azimuth origin would be more satisfactory. *The particular system of units and the specific azimuth origin used is not important, but whatever system and origin is decided upon should be uniform throughout the service and announced in orders.*" Training Regulations No. 160-5, Signal Communication for All Arms, prescribes that the direction of the wind in the Artillery Meteorological Message shall be stated on a basis of 64 points to the circle measured clockwise from the north.

II—Discussion.

2. The wind component indicator now standard for all fixed batteries does not permit of setting the wind in mils measured from the north without a transposition into degrees. It is necessary, therefore, to provide for such a setting if the Artillery Meteorological Message as prescribed in Training Regulations No. 160-5 is to be used in fixed coast defenses.

3. Figure 1 is a photograph of a wind component indicator on which has been pasted a paper scale graduated to accommodate gun azimuth settings in degrees, and wind azimuth settings in mils (64 points to the circle). It is to be noted that the azimuth origin for wind measurements differs from the origin for gun azimuths by 180 degrees. The wind azimuth pointer was raised 1/16 inches in order to permit the paper scale to slide underneath it without friction. It was not necessary to change the position of the gun azimuth pointer.

4. It is believed, however, that a paper scale is not sufficiently permanent. A piece of sheet brass about 1/32 inches thick, properly graduated and fastened

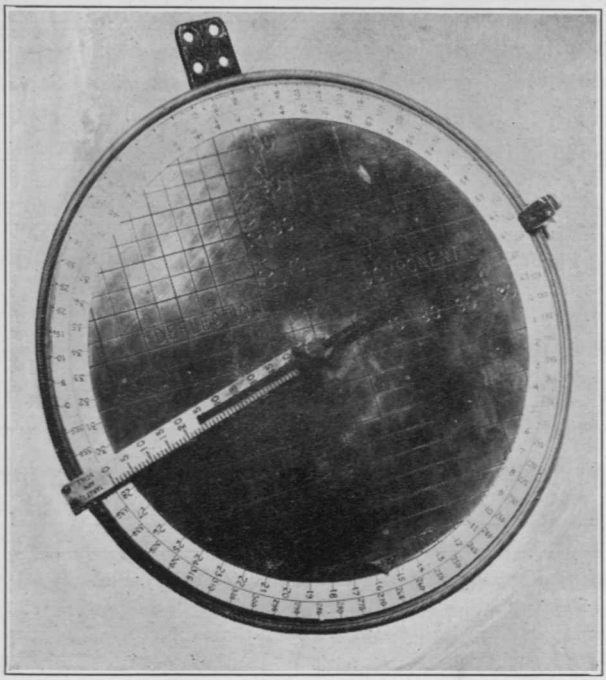


Fig. 1

on top of the old scale by screws would be more satisfactory. A small piece of sheet metal about 1/16 inches thick could be placed underneath the wind azimuth pointer to prevent friction between it and the scale.

5. If the cost of arsenal manufacture of the proposed scales is considered too great it is believed that they can be furnished more cheaply by having the Post Ordnance Machinist do the whole job if he is supplied with suitable drawings. Arsenal accuracy is not needed since wind measurements are never exact.

III—Recommendations.

6. The Board therefore recommended:

a. That a mil and degree scale similar to that described in paragraph 3, be furnished to all fixed batteries at which the wind component indicator is a part of the standard equipment in order that the Artillery Meteorological Message prescribed in Training Regulations No. 160-5 may be utilized at such batteries.

b. That the mil and degree scale be manufactured and issued by the Ordnance Department if the cost is not prohibitive and funds are available.

c. That as an alternative to the recommendation in subparagraph *b*, supra, instructions be given to construct locally the mil and degree scale for all Wind Component Indicators requiring it.

ACTION BY CHIEF OF COAST ARTILLERY.

Third Indorsement

War Department, O. C. C. A., October 27, 1924—To Chief of Ordnance:

1. It is recommended that one hundred nickel silver scales and attaching screws for wind component indicators be manufactured.

2. It is further recommended that upon completion of the scales and attaching screws, they be distributed as indicated below:

C. O., C. D. of Honolulu	2	C. O., C. D. of Portland	2
C. O., C. D. of Pearl Harbor	4	C. O., C. D. of Boston	4
C. O., C. D. of Cristobal	5	C. O., C. D. of Narragansett Bay	2
C. O., C. D. of Balboa	4	C. O., C. D. of Long Island Sound	5
C. O., C. D. of Manila and S. Bays	12	C. O., C. D. of Sandy Hook	4
C. O., C.D. of Puget Sound	5	C. O., C. D. of Chesapeake Bay	5
C. O., C. D. of San Francisco	4	C. O., C. D. of Pensacola	3
C. O., C. D. of Los Angeles	3	C. O., U. S. M. A., West Point, N. Y.	1

The balance to be held awaiting further recommendations from this office.

Project No. 277, Illuminating System for Mobile Seacoast Artillery Units.—

I—HISTORY OF THE PROJECT.

1. The report of a Board of Officers convened by Special Orders No. 63, Fort Kamehameha, May 26, 1924, on "Changes and Modifications in Tables of Allowances and Existing Equipment of 55th Artillery" was referred to the Coast Artillery Board for remark and recommendation. Paragraph *c* of the report referred to an illuminating system for 155-mm. G. P. F. batteries, in regard to which the Coast Artillery Board stated as follows:

> "The Coast Artillery Board believes that a satisfactory lighting system for night firing should be provided for all mobile Coast Artillery units. The Coast Artillery Board is investigating this matter and will report its recommendations in Coast Artillery Board Project No. 277."

II—PROCEDURE.

2. Coast Artillery Board Project No. 199, "Test of Portable Battery Charging Set," and a copy of Paragraph *c* of the report of the Board of Officers was furnished Lieutenant Colonel James B. Taylor, C. A. C., additional member of the Coast Artillery Board at Fort Eustis, Va. The Coast Artillery Board studied the question of an illuminating system for mobile seacoast artillery batteries, considered the report of the Board of Officers, 55th Artillery, and conferred with Lieut. Colonel Taylor and other officers at Fort Eustis in reference thereto.

III—DISCUSSION.

3. *a.* The necessity for an illuminating system in fixed seacoast batteries has been recognized and a satisfactory system provided. The conditions which demand an illuminating system for fixed seacoast artillery also demand it for

mobile seacoast artillery. In fixed installations the system may be more elaborate and questions of weight, size, and portability are not primary considerations.

b. For night firing the elements requiring illumination will be the same for both tractor and railway artillery, but since weight, size and portability will not be so important in the case of railway artillery as for tractor artillery, it may be advisable to equip railway artillery with an illuminating system of sufficient capacity to provide illumination for night firing, and for other purposes in addition.

c. The fire control system for mobile seacoast artillery units is based upon a position finding system using a long horizontal base under normal conditions and a self-contained range finder for emergencies. Manual plotting boards are at present standard equipment. The plotting room, and B. C. station, will be grouped so that it is entirely practicable to transmit power to them from a central source.

d. In some cases it may be objectionable to transmit power from generator to guns on account of length of wires which are liable to be cut by shell fragments. It will not ordinarily be advisable to use 40-watt lights with reflectors at each gun, since so much light may render the position visible to aviators. In view of these considerations, a suitable portable storage battery at each gun should furnish power for illuminating sights, scales, and a "trouble light" for the emplacement. In addition it should be possible to transmit power to each emplacement, should a particular situation justify this procedure. At each of four guns there should be illuminations for the following:

(1) By storage battery—1 cross wires of sight, 2 c.p.; 1 cross bubble of sight, 2 c.p.; 1 elevation bubble, 2 c.p.; 1 elevation drum, 2 c.p.; 1 azimuth scale of sight, 2 c.p.; 1 "trouble light."

(2) Provisions for extending power from central plant to the same elements as in (1) and for two 20-watt lamps, with reflectors, at each of four emplacements.

e. Because of the long power lines required, it will not be practicable to furnish power to base-end position finding and spotting instruments. They and all other azimuth instruments should be illuminated by portable storage batteries. It is believed that the illuminating system provided with the Azimuth Instrument, Model 1918, is satisfactory.

f. Aiming stakes are usually placed from 100 to 200 yards from the gun. Each of four aiming stakes should be provided with one 20-watt lamp, installed in a metal box with attachment for fastening to the aiming stake. The front of such box to have cut out of the metal a vertical slit ¾-inch wide by 8 inches high and the number of the gun to which the stake pertains in four-inch numerals, that is, 1, 2, 3 and 4. Power should be furnished by a generator set.

g. In the plotting stations there should be seven 20-watt lamps. Power should be furnished from a central station sufficiently removed from the plotting station to eliminate confusion resulting from noise in operation of the generator. Seven 20-watt lights will provide illumination for two armsetters, plotter, range and deflection board operators, one for spotting board and leave one spare light. Extension cords should be provided for all lights.

h. The B. C. should have two 20-watt lights in his station.

i. From paragraphs d, f, g and h, it appears that a generating set should furnish power for a minimum of 21 20-watt lights. A power panel and sufficient

wire and lights should accompany the generator set, which should be suitable for charging storage batteries mentioned in Par. *d* (1) and *e*. Attention is invited to Coast Artillery Board Project No. 199, "Test of Portable Charging Set." A generator set similar to this should be satisfactory for mobile seacoast artillery units, both railway and tractor-drawn. A generator unit of some standard commercial type is desirable.

IV—Conclusions.

4 *a*. That a 500-watt generator unit of a standard commercial type and suitable for the uses indicated in paragraphs 3 *a* to *f*, inclusive, should ultimately be supplied each battery of tractor and railway seacoast artillery.

b. That the source of power for illumination at the guns of a battery should normally be portable storage battery, but provision should be made also for utilizing power from the generating set in *a* above.

c. That the generating set should be suitable for charging storage batteries, and the equipment should include switchboard wire and accessories for the lights listed in paragraphs 3 *d* and *i* above.

d. A portable storage battery should be furnished for illuminating lights at each gun.

e. The storage battery supplied with the Azimuth Instrument, Model 1918, is satisfactory as are provisions for illumination.

V—Recommendations.

5. It was recommended:

a. That one 500-watt gas motor generator set complete with accessories and meeting the requirements of paragraphs 4 *a* to *e*, inclusive, be secured and sent to the Coast Artillery Board for service test with a view to adopting a standard.

b. That aiming stakes similar to those discussed in paragraph 3 *f* above be developed and sent to the Coast Artillery Board for service test with a view to adoption as standard equipment.

c. That portable storage batteries be used normally for illumination at guns and that a storage battery suitable for the purposes mentioned in 3 *d* (1) be secured and sent to the Coast Artillery Board for service test with a view to adoption as standard equipment.

d. That mobile seacoast artillery armament should have provision for illuminating the elements mentioned in paragraph 3 *d* (1).

e. That present provisions for illumination in azimuth instruments, Model 1918 are satisfactory, and that all instruments intended for use for position finding or spotting purposes should have similar provisions for illumination.

Action by Chief of Coast Artillery.

First Indorsement

War Department, O. C. C. A., September 29, 1924.—To Chief of Ordnance:

1. Inviting attention to the attached proceedings of the Coast Artillery Board on Project No. 277, "Illuminating System for Mobile Seacoast Artillery Units."

2. The recommendations contained in these proceedings are concurred in.