very destructive, which is unfortunately verified in the Italian disasters. Both earthquakes and volcanoes are more frequently found near the sea coast than inland. In the United States, earthquakes are most common in California. There appears to be a seismic zone encircling the world in which earthquakes are more numerous than elsewhere. It includes Central America, West Indies, Azores, Italy, Persia, Afghanistan, Tibet, Japan, and Hawaii. Earthquakes are common in volcanic regions.

Volcanoes are caused in the main by the same conditions and influences that give rise to earthquakes. But they are different in their manifestation. Volcanic eruptions are caused by leakage or percolation of water through cracks or crevices of the earth or rocks in varying quantities—sometimes in large quantities. As it comes in contact with the great heat in the lower parts of the earth's crust, the water is converted into steam. The steam finds violent vent in an explosion that removes the pressure from the lava, which in turn is forced up through the vent.

This internal heat causes evolution of a great body of elastic vapor, which, expanding and seeking an outlet where there is least resistance, shows itself in upheavals and explosive eruptions. The body of vapor supposed to be derived from superficial masses of earth becomes hydrated, or combined with water. Such action, as well as the presence of molten rock known as lava, is accounted for by vast internal displacements, bringing the inner crust with its high temperature nearer the surface. A great portion of the material thus upheaved is lava.

Lava is largely composed of silica and silicates; those containing a relatively small percentage of silica being called basic, and those containing considerable silica, acid. The acid variety of lava is lighter. Sometimes it does not move from the lava vent, and when it does it generally proceeds a short distance only, solidifying into a thick mass. The basic is much more liquid, and covers the slopes of the mountains or forms a lake on the adjacent plains. At the surface the lava is torn apart by the steam, the fragments being hurled high in the air. The fragments are known as cinders, and when finer as ashes. There are also numerous accessory phenomena, such as earthquakes, electric and magnetic disturbances, and acoustic manifestations, accompanying a volcanic eruption.

Both earthquakes and volcanoes have been inseparably bound up with the evolution of our planet for countless ages past, but their duration must have its limit, although that limit may be tens and even hundreds of thousands of years hence.

The present inert and dead condition of our satellite —the moon—once the center of great volcanic activity, points unmistakably to the fate that sooner or later awaits this earth of ours.

British and German 1909 Warships.

BY PERCIVAL A. HISLAM.

Great secrecy is being maintained concerning the details of the two armored ships to be laid down for the British navy in the current year. The following particulars have, however, been furnished by a reliable authority. The battleship, to be called the "Neptune," will be laid down at Portsmouth, and will follow the same general lines as the "Dreadnought." She will be 510 feet long, with a beam of 82 feet, and her normal displacement will be 20,250 tons. Her main armament will be the same as that of the "Dreadnought"—ten 12-inch guns—but she will probably have 4.7-inch weapons in the anti-torpedo battery. The disposition of the heavy guns will be the same as in the pioneer ship of the class; that is to say, three turrets will be on the center line, one forward and two aft, and one on either beam. The second center-line turret counting from aft will, however, be raised so as to fire over the aftermost, as in the "Michigan" and "South Carolina," thus giving the ship an advantage of two guns over the "Dreadnought" in astern fire. The designed speed of the ship will be 21 knots with turbines of 24,000 horse-power. Plans for a vastly improved battleship are in the possession of the British Admiralty, but will not be used until the ships of the 1909-10 estimates are commenced. The "Neptune" will complete a squadron of eight battleships of the same speed, armament, and general design. She will be completed for sea in the spring of 1911.

The other armored vessel of the 1908-9 programme is a cruiser, named the "Indefatigable," which is to be built at Devonport. This ship will be a greater improvement on the "Indomitable" class than the "Neptune" will be over the "Dreadnought," although the superiority will be largely a nominal one. The "Indefatigable" will be about 570 feet long with a beam of 80 feet, and will displace normally 18,000 tons—700 tons less than the latest German armored cruiser. It will be remembered that all three ships of the "Indomitable" class, although designed for only 25 knots, greatly exceeded this on their trials. The new vessel has been designed for a speed of 28 knots, and if she exceeds the designed figure as much as the "Indomitable" did, she will exceed 30 knots—which is greater than the speed of most of our destroyers. Her horse-power, with Parsons turbines, will be 45,000, or 4,000 more than the horse-power of the "Indomitable." Like the "Neptune," she is to be completed early in 1911, by which time Great Britain will possess eight "Dreadnought" battleships of 21 knots and four all-big-gun cruisers of 28 knots.

The "Indefatigable" will carry the same armament as her predecessors, namely, eight 12-inch guns. In the "Indomitables," however, it has been found very difficult to obtain a broadside of all eight guns, as was sought in the designs, and in the new ship the disposition of the armament will be so altered as to make this operation quite simple.

The German naval estimates for 1909, recently published, plainly indicate the energy with which that nation is pushing forward her naval development. During the coming year Germany will complete her first "Dreadnoughts"—the battleships "Nassau" and "Westfalen," each of 17,760 tons and armed with twelve 11-inch and twelve 6.7-inch guns. In addition, the armored cruiser "Blücher," of 14,600 tons and carrying twelve 8.2-inch and eight 5.8-inch guns, will be completed. The two battleships will join the high sea (or active battle) fleet, but the "Blücher" is destined to relieve the "Fürst Bismarck" on the China station. The 1909 estimates also include the last installments but one for the battleships "Rheinland" and "Posen," each of 17,960 tons and carrying the same armament as the "Nassau" and "Westfalen"; and also for the armored cruiser "F," not yet launched, of 18,700 tons and armed with twelve 11-inch and a number of smaller guns. The speed of all these battleships will be 19 knots, while that of the "Blücher" will be 23, and of the "F" 25 knots, the latter to be obtained with turbine engines of 45,000 horse-power, or 4,000 more than the designed horse-power of the British cruisers of the "Indomitable" class. Two small cruisers—the "Kolberg" and "Ersatz Jagd"—will be completed during the year, as well as a gunboat for river service in China and a division of twelve torpedo-boat destroyers. The cruisers are of 3,740 tons and 25.5 knots, having turbines of 18,000 horse-power, their armament consisting of ten 4.2-inch and a number of smaller guns. The destroyers are of 660 tons and 30 knots.

The other vessels upon which work is to be continued during 1909, and which will not be completed before 1911, are the three battleships to replace the "Beowulf," "Siegfried," and "Oldenburg," the armored cruiser "G," two small cruisers to replace the "Schwalbe" and "Sperber," a division of destroyers (twelve), and a number of submarines. Authentic details of these ships are lacking. During the year a commencement will be made with work on three new battleships, to replace the "Frithjof," "Hildebrand," and "Heimdall," the armored cruiser "H," two small cruisers to replace the "Bussard" and "Falke," twelve torpedo-boat destroyers, a tender for the torpedo experimental division, and several submarines, the latter to cost $2,500,000. Several of the large vessels in the fleet are to be taken in hand for thorough repair, and two floating docks are to be built, one with a lifting capacity of 40,000 tons for the imperial dockyard at Kiel, and one of 1,000 tons (for torpedo craft) for the imperial yard at Danzig.

The programme of warship construction may be summarized as follows:

	To be completed.	To be continued.	To be commenced.
Battleships	2	5	3
Armored cruisers	1	2	1
Small cruiscrs	2	2	2
Destroyers	12	12	12

The Current Supplement.

Mr. F. P. Veitch's article on paper-making materials is concluded in current Supplement, No. 1725. Mr. W. A. Tookey writes on oil engines. W. Carlile Wallace contributes an article on some recent inventions as applied to steamships. When a man of science is asked what caused the earthquake at Messina, he must confess his ignorance. Dr. F. A. Jaggar shows how very little we know about earthquakes, and outlines the proper method of studying seismic disturbances. "Liebig as a Teacher" is the title of an article which gives an admirable picture of a great chemist's personality. Prof. R. A. Fessenden's paper, giving a brief history of wireless telegraphy, is concluded. The nature and cause of seasickness are explained. Prof. Otto N. Witt, the well-known German chemist, writes instructively on waste and conservation of natural resources; and the issue also contains articles on the first Paris Aeronautic Salon and on the general characteristics and details of construction of French flying machines.

Weather-resistant Plaster Mortar.—Mix 6 parts of freshly-burned plaster, 3 parts of brick dust, and 4 parts of blast-furnace slag sand with sufficient water, into a mortar and immediately before use add 2 parts of iron filings.

Correspondence.

ORIGIN OF THE WORD "SCIENTIFIC."

To the Editor of the Scientific American:

The leading dictionary reports as not found the word "scientificus," from which our word "scientific" is derived. Your issue of January 26, 1907, reported the Latin "scientificus" as found in Robert of Lincoln, in or about 1246. Progress may now be reported. In translating Aristotle, Boethius, in the early part of the sixth century, repeatedly uses the word "scientificus," to render Aristotle's "epistemonicos" (see Boethius, vol. 64 of Migne's Latin Patrology, 720 A, 973 C, 993 D, 1039 C). It is well known that these works of Boethius were forgotten until the revival of the thirteenth century, in which Albertus Magnus was the leader. Since then, the interesting word has been the common possession of mankind. It was started in Greek by Aristotle, it was given its Latin form by Boethius, it was introduced into the literature of science by Albertus Magnus. C. W. Ernst.

Boston, Mass.

AEROPLANES IN WARFARE.

To the Editor of the Scientific American:

In a recent issue of your magazine you represent on your front page a Wright flyer with two men in it making a map of the country of an enemy. In the magazine you state that in all probability the only use for this type of machine will be for scouting, as you consider that the modern open-order formation for infantry will prevent much damage being done by bombs dropped from above. Have you not, however, overlooked the vulnerability of headquarters? Flyers would not trouble infantry, but would make for the opposing headquarters, and how could these be protected in a way that would still allow the staff to see and know what was going on? With Wright flyers common, I can not see how any staff could direct an army and keep itself out of the danger zone. With the safety of the general staff gone, what would become of the *morale* of an army?

In defending a city against an approaching fleet, the possible damage flyers could do is very great. Several hundred of them, each equipped with a bomb of dynamite, could be sent out from a base, each returning, after dropping its bomb, to reload, and this line of flyers could sail out and back for hours, returning simply for bombs and gasoline. These machines could attack a fleet twenty miles out, and what chance would the fleet have of reaching the coast through this rain of dynamite? Flyers and men are cheap where it is a question of destroying battleships.

I am of the opinion that the Wright flyer offers the cheapest method of defense against an opposing force ever invented, and that the effect of its use will be to diminish the cost of self-protection and to decrease the chances of war by so increasing the size of the danger zone as to make war as dangerous to the commander as it is now to the private.

I would be pleased to have you publish this in your magazine, and would like the comments of others on this point. A. A. Merrill.

Boston, Mass., December 22, 1908.

MULTI-HULL STEAMSHIPS.

To the Editor of the Scientific American:

In your article in the Scientific American for January 9, you give an account of a projected three-hull type of fast ocean steamer, and in your discussion of the matter, you appear to have mixed up the swinging saloon steamer "Bessemer" and the catamaran steamer "Castalia."

As to the newness of the plan, I have in my possession the plans of a ship of the same type, which were patented by a Capt. Coppen, an old North Atlantic captain, who built and ran some of the very first steamships on ocean routes, and which plans he gave me over twenty years ago. You will find these plans discussed in London Engineering or Engineer for that time, also in Preble's "History of Steam Navigation."

The "Bessemer" was a single-hulled ship, of about 350 feet length and 60 feet beam; she had turtle decks at forward and after ends, 48 feet in length, with a freeboard of only 3 feet, while the rest of the hull was covered with a superstructure having a freeboard of 11 feet.

This superstructure contained the swinging saloon, which was hung compass fashion, with the addition of hydraulic buffers, which took up or controlled the motion. The saloon was 70 feet long, 35 feet wide, and 20 feet high. In the two ends of the midship house were located the engines and boilers.

There were two paddlewheels on each side, 106 feet center, 27 feet in diameter, with twelve feathering buckets each.

She was expected to run ferryboat fashion, without having to make a turn. The engines developed 4,600 horse-power, and were expected to drive her 18 to 20 knots. With her low freeboard she could not be driven, as the seas nearly pounded her to pieces.

The "Castalia" was a catamaran of two hulls; her length was 290 feet, beam 60 feet, with a well or space of 26 feet between the hulls, in which were two paddlewheels abreast on independent shafts, each wheel run by two separate sets of engines.

Great speed was expected, but she did no better than the vessels then used in crossing the Channel; in fact, she was not their equal, as the seas choked the wheels. She was laid up, finally sold, and on her deck were built a number of houses, and she became a floating hospital.

The "Castalia" was built in 1873, and the "Bessemer" in 1875.

The Engineer and Engineering for those dates have, I am told, articles thereon. See also Preble's "History of Steam Navigation," pages 247 to 249, 278, and 410.

In Capt. Coppen's plans, the central hull is considerably shorter than the wing hulls, and he has the propellers arranged at each end of this central hull, in the manner of our new-style ferryboat, as first placed in the Hoboken ferryboat "Bergen"—one to pull, the other to push. James M. Lincoln.

New York, January 7, 1909.