Correspondence.

Air Resistance to Moving Bodies.

To the Editor of the Scientific American:

The newspaper reports of Mr. Adams' experiments with air-splitting trains, and the ill-considered theories which he has taken the trouble to publish, lead one to wonder why he adopted such an expensive and cumbersome plan of proving the fallacy of these theories, which even the highly colored accounts referred to establish beyond dispute. The speeds claimed were not extraordinary, taking the capacity of the engine and the weight of the train into account, except when descending the grades, and even the maximum speed of 102 miles per hour has been equaled, with a heavier train, on one of the level roads between Philadelphia and Atlantic City.

If air resistance is such a dominant factor in the consumption of the power of the engine, why did not Mr. Adams' train run faster on the grades? Either this resistance does not exist, or else Mr. Adams' housings did not remove it. We are all familiar with the remarkable run, made on one of the Chicago and Buffalo roads, a few months ago, when a very commonplace locomotive, with a heavier train, on about an equal grade, out-raced Mr. Adams' train by several miles per hour. The exact figures cannot at present be given. but the statement is approximately correct. It is also a well-established fact that the drawbar pull or traction effort of the engine does not increase on level roads with the higher speeds, except under accelerative stresses, which, of course, are at all times proportionate to the inertia of the train and the increase in speed. On the contrary, it has been shown by tests, published in The London Engineer, that at certain uniform speeds, above fifty miles per hour, the tractive power demanded is even less than at lower speeds. What becomes of Mr. Adams' theories if this is true? It was clearly shown that the horse power developed was considerably less at these high speeds, back-pressure and "wire-drawn" admission being the chief obstructions to the attainment of higher cylinder power. After a certain speed is reached the horse power of the engine cannot be increased, and frequently cannot be maintained, owing to these difficulties of admission and exhaust, together with a limited boiler capacity; and this is the mysterious resistance that has switched Mr. Adams off on the wrong track.

A heavy head wind is not a serious obstruction to the attainment of high speeds, in spite of the greater atmospheric density induced thereby, but side winds are fruitful causes of late trains, which show beyond question that friction and not air resistance is the arch enemy of high speed. In still weather a large body of air is swept along with the train, but, moving at lower velocities as the distance therefrom increases, shows conclusively, although it is a self-evident truth, that each stratum of air passes over the next, with much less friction, than the innermost stratum would sweep over the walls of a train however smooth or unbroken, and that this stratum, therefore, although a thin one, has practically the same velocity as the train. Anyone who has not learned this by observation, may do so by holding the hand close to the outside wall of a fast train, below one of the windows. It is surpassingly strange that such evidence as this should be ignored by a student who makes a specialty of this interesting subject. W. F. Cleveland.

Penetang, Ontario, Canada.

Ethnology at the Pan-American Exposition.

BY DR. A. L. BENEDICT.

The Exposition has provided a circular building 128 feet in diameter, and has also arranged for a "Six Nation" Indian Exhibit on the grounds, with a representation of the typic "Long House" of the Iroquois and an attendance of some sixty Indians, who will be engaged in such industries as basket-making, woodwork, etc. As these Indians are pagans and have preserved to a great degree their ancient customs, they will celebrate in appropriate seasons their various thanksgiving festivals, dances, and other rites.

Every precaution will be taken to protect exhibits against fire or theft and loss in packing and unpacking. It is expected, therefore, that a large amount of valuable archæological material will be placed at the disposal of this department by museums and individual collectors. In fact, it is not too early to assure the public that the promises of such institutions as the American Museum of Natural History, the Peabody Museum, University of Pennsylvania, University of Chicago, and the Buffalo Society of Natural Sciences, as well as the friendly co-operation of the ministers of the South American republics, guarantee the success of this department. At the same time, there is always room for more, and as the aim of this department is not so much to get together a large miscellaneous collection of relics as to afford a means of popular instruction in American archæology, it is desired that students from all parts of the country shall send on exhibits or memoranda descriptive of results obtained in their special fields of labor. For example, one exhibit will show the animals domesticated by the aborigines of the Western Continent, and will explain why the lack of large, useful animals capable of domestication hampered the development of civilization in the New World.

Through the co-operation of the Department of Agriculture and Horticulture exhibits will be made of the plants cultivated in both North and South America before the discovery.

Often the placard is of as great value as the specimen, and one of the features of the exhibit will be cases describing in brief various types of stone age implements and the method of manufactering them. Any student of American archæology, who has elaborated some special phase of the subject and wishes to place his work before the public may send on manuscript, and placards will be made from it, with due credit to the investigator. While such placards should be illustrated by actual specimens, it is not necessary that the specimens should occupy a great amount of space, and in many instances we may be able to supply needed illustrations if proper descriptions are sent. One point, however, we would like to have made perfectly clear, namely, that mercenary collectors will not find the Pan-American Exposition a source of revenue, although there would be no objection to a modest advertisement placed in a case of relics which are otherwise of scientific value.

FIRST-CLASS BATTLESHIP "KENTUCKY."

With the departure of the first class battleship "Kentucky" to join the North Atlantic Squadron, the United States Navy is strengthened by the addition of the second of a pair of battleships which, because of certain novelties in construction, have attracted, perhaps, more attention than any other vessels in our navy. The "Kearsarge" and the "Kentucky" were authorized on March 2, 1895, and the contract for the construction of both vessels was secured by the Newport News Shipbuilding Company, these being the first battleships to be undertaken by that now famous yard.

At about the time that they were authorized Lieut. Strauss, of the navy, had proposed that, with a view to securing the greatest possible amount of all-round fire, the 8-inch guns of the intermediate battery should be superposed above the turrets containing the main battery of 13-inch guns. The idea commended itself to Admiral Sampson, who was at that time Chief of the Bureau of Ordnance, and after a considerable amount of discussion it was decided to give the proposed system a trial upon the two new battleships, which at that time were known as Nos. 5 and 6. The design of the Bureau of Ordnance was taken in hand by the Construction Department and the details of the installation of the guns in the double turrets were very skillfully worked out by Naval Constructor Woodward. Advantage was taken of the rapid improvements which had been made in the electrical arts to provide a complete electrical equipment for the operation of both the turrets and the guns. The keels of both vessels were laid on adjoining slips on January 30, 1896, and 21 months later, March 24, 1898, both vessels were launched with imposing ceremonies; this being the first instance, we believe, of a double launching of battleships in the history of our modern navy. The "Kearsarge" was the first of the two vessels to be completed, the delay, both in her case and in the case of the sister ship, being due largely to the incomplete state of the armament. The two vessels are practically identical, and a description of one will, therefore, apply very closely to the other.

The "Kentucky" is 368 feet on the waterline, has a beam of 72 feet 2½ inches, and when the ship is fully equipped, ready for sea, with all stores on board and a normal coal supply of 410 tons, her maximum draught will be 25 feet 1 inch, and her displacement 11,525 tons. This is an unusually moderate draught for a battleship of over 11,000 tons displacement, and it is gratifying to know that these ships and the later vessels of the "Maine," the "Alabama," and the "Georgia" classes are to be restricted to the same draught. The later battleships of foreign navies exceed these vessels in draught by from 1 to 3½ feet; thus, the "Kaiser Friedrich," of the German Navy, draws about 26 feet, the French "Jaureguiberry" 27 feet 9 inches, the Italian "Re Umberto." 28 feet 6 inches, and the British "Majestic," 27 feet 6 inches, while the "Italia," of the Italian Navy, draws 31 feet 6 inches; although it is scarcely fair to include this vessel, which was launched in 1880, in the present comparison. The advantage of a moderate draught can scarcely be overestimated, and in naval operations that are conducted in shoal waters, it may easily prove to be the decisive factor. Were our own shore the object of attack and the exigencies of the campaign demanded that we should act on the defensive, it would be possible for our ships to retire into harbors and channels, into which the attacking ships, because of their greater draught, could not enter; and if we should be carrying on a campaign in foreign waters, it would be possible for our heavily armored battleships to enter bays and harbors and pass through straits which would be closed against the deeper armored ships of the enemy.

The defensive qualities of the "Kentucky" are of a very high order. In the first place, the whole of her armor has been treated by the Harvey process, and although ton for ton, it is inferior to the Krupp armor, its greater thickness will put the "Kentucky" on fairly equal terms, as regards protection, with the latest battleships of foreign construction. The waterline armor extends from abaft the after superposed turrets forward to the bow, and the absence of vertical waterline armor from the after turret to the stern is compensated for by giving the curved protective deck in this locality a thickness of 5 inches. The belt extends from 3 feet above to a depth of 4½ feet below the waterline. Amidships this belt is 16½ inches thick on its upper edge and tapers vertically to a thickness of 9½ inches on its lower edge. It also diminishes in thickness gradually from amidships to either end, the thickness of the bow being about 4 inches. Massive bulkheads also extend across the ship abreast of the barbettes to a junction with the side armor, thus presenting a complete wall of vertical armor around the engine rooms, magazines, and boilers. Above this belt is a flat deck of Harveyized steel which is 2¾ inches in thickness. Forward of the turrets this deck is of a turtle-back form and 3 inches in thickness. It curves down gradually toward the ram bow and is worked into the structure of the ram, serving to greatly stiffen the latter and to assist in transmitting the shock of ramming throughout the whole structure of the vessel. Barbettes of 15-inch steel are built up from the protective deck to a height of 3 or 4 feet above the main deck, and above these are carried the superposed turrets, the turning gear and ammunition hoists of the turrets being protected by the barbette armor. The greatest thickness of the armor on the lower half of the turrets is 17 inches, and on the upper half, containing the 8-inch guns, the armor is 11 inches in thickness. The space amidships between the superposed turrets is occupied by a powerful secondary battery of fourteen 5-inch rapid-fire guns, which are carried seven on each broadside. The whole of this battery is inclosed by a wall of 5½-inch armor, which not only protects the guns from direct attack on the broadside, but also extends obliquely across the ship and prevents the enemy from raking the battery from an end-on position. Mounted on the superstructure deck above the secondary battery are a dozen 6-pounders, eight of which are mounted in broadside, while the other four are mounted so that they can fire on the broadside or dead ahead or dead astern. On the berth deck are eight other 6-pounders, four of which are mounted in the bow and four astern.

The electrical installment of the "Kentucky" is more complete than has been supplied on any previous battleship, except, of course, her sister ship the "Kearsarge." Two 50 horse power motors are installed in each turret for turning the same; 20-horse power motors operate the ammunition hoists to the 13-inch guns and 6-horse power motors perform the same service for the 8-inch rifles. There are also special electrical motors for elevating the guns, working the rammers and blowing the gases out of the bores of the 8-inch and 13-inch guns. In addition to the plant connected with the turrets, electric power is utilized in the operation of 10 endless-chain, ammunition hoists for the 5-inch and 6-pounder guns. There are also six electric deck winches, and the four big boat cranes, which project above the superstructure, are also operated by electric motors. The ventilating of the ship is performed by thirteen electrically-driven ventilating fans.

The view on our first page, showing the "Kentucky" under way, gives an excellent idea of the very shapely appearance of this handsome vessel. Whatever may be said of the advantages or disadvantages of the double-turret system, it cannot be denied that, on the score of appearance, there is a decided gain. The concentration of the heavy guns at either end of the ship and the long line of the 5-inch rapid-fire battery, with the 6-pounders above it amidships, has a look of simplicity and convenience. If one could suggest a feature that would add to her beauty, it would be the raising of the free-board from the bow to the foremast by the height of one deck, as in the case of the ships of the "Alabama" and "Maine" classes.

The official trial trip of the "Kentucky" took place on November 24, 1899, over a measured 33 sea-mile course between Cape Ann and Cape Porpoise. The vessel was run over the course twice and the mean speed for the two runs with tidal connections was 16·9 knots per hour; the horse power developed by the main engines being 11,081·9, and by the auxiliaries in use 236·5. The coal consumption worked out at 2·63 pounds per horse power per hour.

The Library of the Temple at Nippur.

Dr. H. V. Hilprecht, of the University of Pennsylvania expedition into Nippur, has arrived at Constantinople after having discovered the library at the Great Temple, and over 17,000 tablets dealing with literary and historical matters. None of them are of a later date than 2280 B. C. The remains of the library will require five years to excavate. There is every indication that the discoveries will give us a complete record of the ancient civilization.