the same size and power, but since the distance from Juncal is 7,000 metres, against 3,000 metres for Juncal-Juncalillo, the power available at Calavera for driving the compressors is proportionately less, and only four compressors are driven.

In the Argentine installation the water-power is derived from the Quebrada Navarro, the water being conveyed to the turbines, a distance of 383 yards, by a single line of steel pipes. Owing to the difficulties of travel upon the Argentine side of the mountains, 80 horse-power dynamos were found to be too heavy for transport, and machines of half the power were therefore adopted. At the primary station at Navarro four Girard turbines of 80 horse-power each are used. Each turbine drives two 40 horse-power dynamos directly from its horizontal shaft, one on either side. The machines are in two groups, each of two turbines with four dynamos. One group can be worked independently of the other, should any accident arise, provided it does not affect the source of water supply. The 30 horse-power motors at Las Cuevas are similar to the dynamos at Navarro, and there is about 224 horse-power available for driving the compressors, which are of the same type as those for the Chilian installations. In the three installations, the air is conveyed from the compressors into large steel reservoirs, and from thence to the drills in wrought-iron pipes. The drills are mounted upon carriages, in groups of six, and are run forward on rails to the work.

The several stations are connected by telephone, so that, although the works are widely separated, the same initial power which is, by the various processes, converted into active work at the rock face, affords the means of instant and easy communication with all parts of the works. The workshops are lighted by electricity generated by a separate 10 horse-power dynamo.

THE EXPEDITIONS TO GREENLAND.

ON June 6 the whaling steamer Kite, which has been chartered for the purpose, left this port for Greenland, having on board two parties of explorers bent on adding to our knowledge of Greenland.

One of these parties is under the command of Lieutenant Peary, U.S.N., and is known as the North Greenland Expedition. Of their plans we give an account below. The other is known as the West Greenland Expedition, and consists of Professor A. Heilprin, the geologist, who will command; Professor Holt and Professor Benjamin Sharp, zoölogists; Professor W. E. Hughes, ornithologist; Dr. W. Burk, botanist; Dr. R. N. Keeley and Frazer Ashurst, surgeons; Professor L. W. Mengee, entomologist, and A. C. Kenealy. The West Greenland expedition will, after reaching Whale Sound on the Kite, proceed southward either to Upernavik or Disco Bay and finally to Godhaven, from which point the party will journey in the Kite to Ivigut and thence to St. Johns, Newfoundland. This section of the expedition expects to return about the middle of September.

The plans of the North Greenland Expedition are set forth in a letter from Lieut. Peary to the New York *Sun*, of which we give the following abstract: —

"My party will be landed in June or early in July at Whale Sound, latitude 77° 30′ north. The remainder of this season will be devoted to hunting for the winter's supply of meat, examining the features of the Whale Sound region, collecting natural objects, and more especially to reconnoissances of the inland ice in various directions. It is anticipated that one of these reconnoissances will be carried across the great tongue of the inland ice covering Prudhoe Land to the southern angle of Humboldt Glacier, and an advance depot for the main sledge journey established there. The winter will be occupied in making and fitting sledges, clothing, and all travelling equipment, and in snowshoe and skier practice, for which the level surface of Inglefield Gulf (head of Whale Sound) is especially adapted.

"Early next spring four of five of the party will start over the inland ice to Humboldt Glacier, with full sledges and dogs if practicable. Should favorable advance be made, this party will continue on from Humboldt Glacier to the head of Petermann Fjord. Here a second depot of supplies will be deposited, and from this point the advance party of two or three will push on with full sledges, the others returning to Whale Sound, to devote their tim during the absence of the main party to meteorological observations, collecting, and surveying. The main party will proceed from the head of Petermann Fjord to the head of the Sherard Osborne Fjord, establish a depot there, thence to the head of De Long Fjord, establish a depot there, thence to the northern terminus. This point reached and determined, the main party will retrace its steps to Whale Sound, taking up the various depots, and the entire party will then seize the first opportunity to come out.

"The salient features of the project are the smallness of the party and the utilization of the great interior ice plateau, the imperial highway of inner Greenland, as a road, instead of the sea of ice; and the whole theory of the project rests upon the now well-established fact that the interior of south and middle Greenland is covered with an uninterrupted ice cap, and the more than probability (in my opinion) that in north Greenland the conditions are the same, and the ice cap nearly, if not quite, coextensive with the land."

"My personal impression is that the northern terminus of Greenland is not north of the 85th parallel of latitude, and that the inner ice cap is practically co-extensive with the land; and this opinion is shared by Judge Daly and, I think, by most other eminent geographers. But whether this is the case, or whether Greenland extends as an Arctic continent across the pole, or is connected more or less loosely by detached masses of land with Franz Josef Land, or whether the ice cap ends at about the 82d parallel, as in Grinnell Land, I feel confident that in any contingency the efforts of my party will result in discoveries of interest, and, I hope, of considerable value to the scientific world. Should the Greenland ice cap terminate at or south of the 82d parallel, as Gen. Greely believes, I shall endeavor to follow its edge to the unknown east coast above Cape Bismarck.

"The especial advantages of my overland route over all others I regard to be as follows: the possibility of laying a straight course from point to point, with the certainty that no tidal crack or chaos of heaped-up ice will compel a long detour, or stop all further advance; that every foot travelled is a foot advanced, and the comforting assurance that nothing can happen to cut off the retreat; the even and unvarying character of the surface to be traversed, and the gain in lightness of sledges and equipment, and rapidity of advance resulting therefrom; the length of season (at least six months) during which sledging may be prosecuted; the facilities that the 'nunataks,' or island mountain-tops, which project above the 'inland ice' at distances varying from two or three to forty miles from the edge of the ice, offer for forming depots of provisions; and the exceptional value of the elevation of the route in accurately charting the coast and detecting the existence of more northerly land or lands."

"My base is the one advocated by Kane, Hayes, Hall, Judge Daly, and almost every American Arctic authority,— a region having a small and kindly native population, abounding in game, and within easy reach of the whalers which pass Cape York every year on their way to the fishing grounds in Lancaster Sound and adjacent waters. My proposed line of advance is absolutely direct throughout each stage. If it were not desirable to touch at the heads of Petermann, Sherard Osborne, and the other principal fjords which interrupt the northern coast, and determine their length and the characteristics of their heads, the line of march might follow very closely a great-circle course from the head of Whale Sound to beyond Lockwook's 'farthest.'

"As to the dangers and hardships of an eighteen months' sojourn above the 77th parallel, sentiment and imagination aside, I believe them to be no greater than they would be in northern Norway, Siberia, the higher Alps, or, to come nearer home, in Montana or Dakota in winter. It may be news to many to know that there are now in Greenland, under climatic conditions and environments similar to those of my proposed headquarters, Danish officers with their wives and families, living the same home life as the better classes here, with their window gardens, their music, their books, and all the other accessories of culture. I shall endeavor to collect all the scientific material and make all the observations practicable, but my first and last object will be the at-

tainment and determination of the northern terminus of Greenland, and everything will be subservient to that.

"I shall be accompanied by five young men, and the following particulars about the members of the party may be of interest. John M. Verhoeff of Louisville, Ky., is a young man of twenty-five, educated in an Eastern university, a mineralogist, and, though somewhat below the average in stature, has a magnificent lung development and a record for endurance and cross-country walking. Mr. Verhoeff has contributed generously to the expenses of the expedition. Dr. Frederick A. Cook, the surgeon of the expedition, is an able young physician and surgeon, a native of New York State, a graduate of the College of Physicians and Surgeons and of the University of the City of New York, and has been in practice in New York City for several years. He is twenty-six years old, strongly built, is five feet nine inches in height, weighs a hundred and fifty pounds, and has a lung expansion of five inches. Langdon Gibson of Flushing, L.I., is a stalwart young fellow of twenty-six, and one of the many active and enthusiastic members of the American Ornithologists' Union. He was one of the Brown-Stanton party in the memorable Colorado Cañon survey of 1889–90, and knows what arduous work is. He is six feet tall, weighs a hundred and seventy-eight pounds, and has an exceptionally fine lung development. Eivind Astrüp of Christiania, Norway, is a stalwart young fellow, who has but recently come to this country. He is the son of the commander of the Royal Civil Guard of Christiania, a first-class graduate of the Christiana Commercial College, and a winner of numerous prizes in athletic sports, especially ski-running. He is five feet seven inches in height, weighs a hundred and sixty-seven pounds, and has a lung expansion of four inches. Matthew Henson is a hardy young colored man, a native of Virginia, twenty-three years old. His intelligence and faithfulness, combined with more than average pluck and endurance, as shown during several years that he has been with me through varying experiences, part of the time in Nicaraguan jungles, lead me to regard him as a valuable member of the party. The members of my party are all young, and, in addition to possessing first-class physique and perfect health, they are men of education and attainments. I believe this to be the type of man best fitted to endure with minimum effect the ordeal of the Arctic winter, and to effectively execute a two or three months' dash on sledges, where intelligent will-power, elasticity, and enthusiasm are at a premium over the stolid endurance of muscles hardened by years of work. Mrs. Peary will accompany the party to Whale Sound. Possessed of youth, health, energy, and enthusiastic interest in the work, she sees no reason why she cannot endure conditions and environment similar to those in which Danish wives in Greenland pass years of their life. In this opinion I fully concur, and believe that in many ways her presence and assistance will contribute to the valuable results of the expedition, as they have been invaluable to me in the preparation.

"The food supply of the party is not materially different from that of the later Arctic expeditions. Tea, coffee, sugar, and milk are in quantity sufficient to last two and a half years; other supplies for a year and a half. But little meat will be taken, outside of the pemmican for the sledge journey, as there is an abundance of reindeer, ptarmigan, Arctic hares, foxes, ducks, loons, seals, and walrus in and about Whale Sound. Special items of interest, principally for the sledge journey, are as follows: tea, compressed into quarter-pound cakes, partially divided, like chocolate, into quarter-ounce squares; compressed pea soup tablets, a German preparation; beef-meal pemmican and beef-meal and cocoa tablets, prepared expressly for the expedition; evaporated cabbage, potatoes, onions, turnips, carrots, and apples.

"Next to the food supply comes the house. This will be a light structure twelve by twenty feet (inside measurement) with double walls inclosing a ten-inch air space. There will be a triangular air space between the ceiling of the rooms and the roof sheathing, and the rooms will have three layers of tarred paper between them and the exterior air. The walls of the rooms will be hung at first with blankets, and later probably with skins. The house will be surrounded by a wall of stones, turf, and snow as high as the eaves, leaving a narrow passage entirely around the house, and during the winter this space and the roof of the house itself will covered in with a thick layer of snow.

"The expedition will have two whale boats and several sledges, including the two made and used by me in Greenland in 1886. The new ones, though of the same type, will be lighter than the old ones. Each member of the party will have Indian snowshoes and Norwegian "ski" moccasins and rubber ice creepers."

LETTERS TO THE EDITOR.

**** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Immortality in the Light of Modern Dynamics.

I WOULD like, with your permission, to take issue with the writer of the article under the above title published in *Science* of May 29.

The eleventh paragraph, speaking of the reader of the journal of the Institute having "read the same lines" therein, "an endless number of times," "billions of years ago," naturally suggests doubts of his seriousness; and if I am mistaken in the assumption that a gentleman of his great attainments and high position is surely in earnest while thus treating on scientific subjects before that learned body, the Franklin Institute, and that therefore the paper could not have been intended as a burlesque upon modern science, it must be set down to my "simplicity."

In his illustration by the falling of dice, he truly says that the number of dice used has nothing to do with the truth of the proposition that they must, some time, again present — and with a certain average frequency — the same combination of numbers. Evidently, however, he quite overlooks one element of the case, which omission — a most astonishing one — utterly vitiates his illustration and reasoning thereon.

The matter overlooked is the fact that each one of the dice is limited to a certain finite number of exact positions, in one of which it must fall; and after it has, once or more, fallen in each of these, all subsequent falls must necessarily be exact repetitions of some of these, hence the possible number of combinations is also limited, and then must come repetitions.

Let us suppose, however, that the dice, instead of cubes, be perfect spheres, and thrown upon a perfect plane. The number of positions in which any one could come to rest would be infinite, and it is scarcely supposable that it would ever, in an eternity of throws, take absolutely the same position a second time. Now, such is the condition of the atoms spoken of, except that in their case it is more complex, as their are more conditions.

Every particular combination produced must, of course, be simply the resultant of the positions and motions of the atoms. The possible positions and also the possible directions of motion, as well as velocities, are infinite in number, hence the chances are infinity to one against the same combination again occurring even between any two of them, — yea, an infinity of infinities.

Moreover, when the same concurrence of the atoms should occur and reconstruct the same identical form, — of Cæsar, for example, — an essential pre-requisite is, that all influences must be the same as before, hence all surrounding conditions, near or remote, must be identical with those of the former epoch; i.e., the universe must be throughout exactly as before: there are no influences except position and motion, hence every identical atom must be, at the one instant, in the same one of the infinitively various positions, moving at the same one of the infinite different velocities, and in the same one of the infinitely different directions, including the infinite various vibrations, as before, — all this while it is incredible that any one of them will ever move in absolutely the same direction a second time, or that any one of the conditions requisite to the repetition of a former combination will ever exist.

An infinitesimal difference from the former time in the case of any one atom in the universe in any particular at that instant