#### THE EARTHQUAKES.

Exploration of the Volcane of Kilanca-Won-derful Effects of Eruption in the Sandwich Islands-The Peruvian Disturbances-The Great Earthquake Waves.

Hilo, Hawaii, Sept. 20.—I have lately re-turned from a tour of exploration to the active erater of Kilauea and the volcanic district of Puna. At Kilauea the action was dull. The central area of this immense crater remains a deep concavity, depressed about 400 feet below its margin; but this margin is a new vein or black ledge of lava, itself depressed a thousand feet below the banks of the crater, and marking the former level of its bottom. In this profound basin I noticed a scanty growth of ferns rooted in the superficial strata of lava. They had gone down uninjured to a depth of 400 or 500 feet, as the crust subsided upon the discorgement of the molten lava beneath. The old South Lake re-tains its locality, but its contours are entirely

It is now a nearly circular pit, about 400 feet deep in the bottom of the crater. Its diameter, as I measured, is four-fifths of a mile, and its walls, of black hardened lava, are jagged and frowning; in some places beetling; in others, perpendicular or retreating. To this sombre abyse access is anything but easy; it is possible to enter it at but a single place, and by making a trajet over a steep, rugged, and difficult incline of debris, yet a brave American lady of my party ventured to descend under my guidance. 2000 feet below the surface of the ground, we tramped together over the floor of the awful pit. It seems now the half-cooled forge of Vulcan; the flory billows no longer roll and break as they were wont to do over this vast area of indurated lavas; yet, in many places we could look into red-hot ovens and chimneys, and peer down through orifices in the crust to the molten sea below, and hear and see and feel the incandescent minerals boiling, bissing, and surging, lashing the sides of the infernal cavern, and sending up volumes of white sulphur vapors like the broth of Pluto, or like the "smoke of torment," spoken of in that terrible passage in Revelations, "which ascendeth forever." But now this principal focus of volcanie action is comparatively quiescent. Our last great eruption has lowered its flery tides far below their usual level; and we are content to enjoy this full in the strife of the telluric forces, which are so ably described in Dr. C. F. Winslow's which recent work on Force and Nature -a work which gives the completest explanation that has yet appeared of volcanic phenomena in Hawaii. I spent three days at Kilauca, making careful observations of the crater; and, when these were completed, went to the seashore at Ke-a-la-komo, a village in the volcanic district of Puna, situated about twenty miles from Kilauea. this district the subsidence of the land was dis-tinctly marked. Throughout a coast line of many miles in extent the shore has settled from six to eight feet. On the 25th of July last a remarkable flood-

tide visited the southern shore of Puna, tearing away the faces of the sea-cliffs, sweeping over barriers twenty-five feet high, rolling in foaming surfs hundreds of feet inland, and carrying with it huge boulders and augular masses of rock from a ton to three loss in weight. The sea rose nearly thirty feet in perpendicular height, or ten feet higher than the great earthquake wave, already described in your columns of the 2d of April, 1868. Several houses which were not reached by that wave were swept away on the 25th. By the latter calamity nearly everything has been destroyed upon the high shores of Ka-ha-na-le-a, and the delicious bath in the fis-sure at Pu-na-luu is doubled in depth.

Nor are the changes that the plastic volcanic agency is impressing upon this country yet comoleted. At Ka-la-pa-na the sea is more and more invading the land. Two channels are opened through the beach, and the tide ebbs and flows over large fields of the Ka-la-pa-na plain. The old stone church of the village is deeply buried in sand and boulders, and the tides sweep entirely over it. From Ka-mai-ll to Ka-po-ho the shores are terribly torn by the action of the volcanic waves. Between the villages of O-pi-hi-kaa and Po-ho-i-ki the waves dashed a thousand feet inland, and destroyed a mile of road running parallel with the shore, upon a line never before reached by the sea. But for the declivity of our shores, these gigantic waves would have penetrated much further inland. What ruin would not be done by a succession of billows 30 feet higher than the highest tides, hurled violently upon the coasts of New York and New Jersey! An electrical storm occurred at the same time with these phenomena (July 25), and hundreds of large mullet were killed, apparently by this cause, in the "Green Lake" (Wal-a-Pe-le), at Kapoho. The point of disturbance, from which these remarkable waves radiated, is still unknown to us. The focus of the great Peruvian earthquakes of 1868 was near the city of Arica, where the first shocks were felt at 4.45 P. M., Aug. 13. The resulting earth-quake wave reached our islands, a distance of 6000 miles to the northwest, late at night upon the same day, and travelling toward the south-west, reached the harbor of Lyttleton, New Zealand at 4% o'clock in the morning of the 15th. Making the allowances in time required by a difference in longitude of 245 deg, 18 min. (counting eastward), it appears that the wave occupied but 19 hours and 17 minutes in making the latter distance of 7200 miles. This makes 368 miles per hour, or 540 feet per

second, about half the nominal velocity of a cannon ball. On the 23d of December, 1854, a similar wave was transmitted across the entire breadth of the Pacific Ocean, from Japan to California, in twelve hours and thirty-eight minutes. The great earthquake wave of April 20, 1868, passed from our Hawaiian shores to the coasts of Mexico, California, and Oregon, in five hours' time, as indicated by self-registering tide-gauges at San Francisco and Astoria, which announced its arrival upon the evening of the same day in which it had desolated the coasts of Puna and of Ka u. These waves are entirely distinct from the tidal swing of the ocean, and are proper waves of translation, in which the particles of water moved bodily forwards and backwards, like those of the air in sound waves. They convey an impressive idea of the tremendous power required to disturb the whole body of the Pacific Ocean for 10,000 miles in either

direction. I returned to Hilo by the coast route, experiencing occasional earthquakes by the way, some of them a little startling. These still continue at intervals; but we are inclined to expect a season of comparative volcanic quiet at present, and have no sensation, in the way of natural phenomena, in definite prospect earlier than the transit of Venus in 1874. We are already promised visits by scientific observers upon that occasion.

## Cholera in India.

An East Indian correspondent of the Pall Mall Gazette writes as follows about the choiera

Invasion is the latest word adopted by the doctors to express the advent from year to year of epidemic cholera. The term is not unhappily sen as characterizing the swift, simultaneous irresistible, irregularly regular sweep of the dis-case over the provinces lying powerless in its path. Never starting from a centre in those countries where it is not indigenous, it advances from its lair in the great delta of the Ganges, known by sanitary authorities as the cradle of endemic cholera, and thence, other conditions being favorable, presses forward until checked by the winter months, when it hybernates, and after undergoing its normal period of dormancy comes forth with the spring revitalized, and, like a giant refreshed, ready for further manifestations in the area already covered and for epidemic progress into those districts it had been unable to invade in the preceding year, and so, on and on, year by year, with the carayans across Central Asia, or in the pligrim ships of the Red Sea, through Egypt and Turkey, over the continent of Europe to the kingdom prepared for it in the filthy slams of the great cities of England, never staying in its course until its virus is expended or the conditions of earth and sky refuse any longer to

further it on its way. Such, at least as I understand it, is the invathe in India incline to accept. It certainly scale, - Rushin,

derives support from the course taken by the epidemic visitations of this and last year. Whether, as is confidently asserted, the theory stands the test of a close research into the his tory of past epidemies, I am not in a position to say. Its defenders to establish their point must show that cholera has never appeared in a sporadic form in the Northwest Provinces, the Deccap, the Punjaub, or the countries lying beyond the British borders, but has invariably been borne along an unbroken series of cholera waves from the Gangetic delta. But what more immediately concerns us is how to repel or evade the attacks, which, come from what quarter or originate how they may, constitute the most formidal le enemy the British in India have to contend against. Until we know what manner of thing our enemy is, and where he can be smitten, a knowledge from which we seem as far as our fathers were, repulsion is an impossibility. Evasion has been tried, and frequently with success, but the flights are necessarily somewhat empirical, and it has happened that a regiment attacked by the discase has been removed from a comparatively lightly visited district into one virulently affected. This year the epidemic, illustrating the invasion theory, has reoccupied its last year area—namely, Bengal, part of the Northwest, and all the Central provinces—and has invaded Rajpootana, Onde, and the remainder of the rthwest as high as Agra. Hitherto Meerut Robilcund, and the Punjaub have escaped though precursory symptoms have appeared in Umritsur. We may however, confidently hope that the epideade, for this year at least, has done its worst. Accounts from the stations where disease has been rife grow dally more satisfactory, and from many-notably Allahabad, where the mortality was greatest-it has disappeared altogether. have not been able to obtain trustworthy ac counts to date of the mortality amongsi the general population: but it has been terribly heavy-to be counted by tens of thousands Amongst the British troops, including women and children, the total number of deaths has been about 370. This is not an extraordinary number for a year of epidemic, but the distin-guishing characteristic of the choicea of 18.3 is its virulency. Of those seized more than two-thirds died. Dr. Cuningham, Sanitary Commissioner to the Government of India, has recommended the adoption of a more extended trial of the evasion system of battling cholera. Some districts, lamentably few in number, are remarkable for a comparative immunity from the disease. Where these are attainable rail, and not more than 150 to 200 miles distant, Dr. Cuningham proposes that regiments in which cholera appears at all shall be at once removed to them. The scheme is admittedly merely experimental, but Lord Mayo has decided to give it a full trial when occasion may arise. The district civil officers in communication with the officers of the quartermastergeneral's department have been busy, therefore, in selecting sites for camps in the favored districts near the line of rail, but far enough from owns or populous villages to avoid the risk of infection on either side. Meanwhile detailed in-structions have been issued from army headng troops entrusted with the execution of the

I sincerely hope I shall not have to touch on the subject of choices in any subsequent letter, but at the risk of wearying you with this not very inviting though important topic, I will quote a paragraph from a very late memorandum on this year's epidemic by Dr. Bryden, of the Sani-

tary Commission Office:

"Were the cholera (he says) of 1850 now to be stopped in its geographical distribution, the cholera of the year would present throughout the Bengal of the year wound present throughout the Bengal Presidency the precise distribution of the cholera of 1860; powerful epidemic advance from the East has occurred up to 80 deg; the northern and southern epidemic highways have been universally occupied, and Meerut, Rohilcund, and the Punjanb have re-mained as yet an exempted area. The meteorology of 1870 within the exempted treat, yery much resenof 1850 within the exempted tract very much resem-bled that of the monsoon scason of 1850 within the same limits, and it is an unpleasant reflection that the exempted cholera tract of 1860 became on account of its exemption the famine tract of 1861. The geography of the exempted choicra tract of 1862 and of the famine tract of 1861 will be found to be absolutely identical. Even now within the uninvaded tract of 1865 the rains have been extremely deficient, and for a fortnight they have ceased altogether.

## Aut Breeding.

A few years ago, the inhabitants of a particular street in Paris were attacked with an unaccountable irritation of the epidermis, which compelled them to scratch themselves from morn till night, no considerate Duke of Argyle being there to take compassion on them. The result was that they scarified themselves bit by bit, and any one seeing them would have thought that leprosy at least had fallen on the quarter. An inquiry was instituted by the authorities, when it was discovered that the proximity of a certain Mademoiselle Rose, breeder of ants, for the sake of their eggs for fattening young pheasants, was the cause of the calamity. On the police visiting the establishment, they encountered a woman between forty and fifty years of age, and of a terrible aspect, her face and hands being as completely tanned as though they had undergone dressing at the hands of a skilful currier. This was the result of continuous attacks on the part of her ungrateful pupils, whose inroads upon her person had forced her to encase the rest of her body in buff leather. Thus protected she slept at buff leather. Thus protected she slept at night surrounded by sacks full of her vivacious merchandise in perfect security, and seemed much astonished at the police visiting her establishment.

'How can any one venture to complain of these little insects?" remarked she. "Why, I live in the very midst of them, and do not feel any the worse. Some one must have a spite against me, I am certain—the world is so wick Despite, however, of all she could urge, Mademoiselle Rose was obliged to transport her strange boarding establishment to a perfectly isolated building beyond the barrier, and in due course the cutaneous irritation experienced by her late neighbors was allayed.

Mademoiselle Rose had her correspondents in many of the departments of France, more especially in those where very large forests exist, and paid them at the rate of a couple of francs a day. Her aggregate daily consignments were about half a score of large sacks, her profits on which amounted to thirty francs. the was proud of her trade, and maintained that she was the only person who thoroughly understood the fecundation of emmets, having long since made it her business to study the manners and customs of these lusects. "I can make them," she used to say, "lay eggs at will, and produce ten times as many as they do in a wild state. To accomplish this I place them in a room where there is an iron stove kept heated red hot. I allow them to make their nests where they blease, as it never does to interfere with them. They require great care, and the more attention you bestow upon them the more money they will bring you in. their eggs to the chemists, and supply the Jardin des Plantes and most of the breeders of pheasants in the neighborhood of Paris with them. The young birds have a particular liking for the kind of food."—All the Year Round.

The Serpent's Motion.

cannot understand this swift forward motion of serpents. The seizure of prey by the constrictor, though invisibly swift, quite simple in mechanism; it is simply the return to its coil of an opened watch-spring, and is just as instantaneous. But the steady and continuous motion, without a visible fulcrum (for the whole body moves at the same instant, and I have often seen even small snakes glide as fast as I could walk), seems to involve a vibration of the scales quite too rapid to be conceived. The motion of the crest and dorsal fin of the hippocampus, which is one of the intermediate types between serpent and fish, perhaps gives some resemblance of it, dimly visible, for the quivering turns the an into a mere mist. The entrance of the two barbs of a bee's sting by alternate motion, "the teeth of one barb acting as a fulcrom for the other," must be something like the acroent motion on a small

Modern Mechanical Science. From the interesting address of C. W. Siemens, F.R.s., before the Mechanical Science Section of the British Association, republished by Van Nostrand's Engineering Magazine, we present several points of interest:

PATENTS.—The greatest illustration of the beneficial working of the patent laws was supplied, in my opinion, by James Watt, when, just about one bundred years ago, be related his

about one hundred years ago, he patented his invention of a hot-working cylinder and separate steam-engine condenser. After years of contest against those adverse circumstances that beset every important innovation, James Watt, with failing health and scanty means, was only upheld in his struggle by the deep conviction of the ultimate triumph of his cause. This convic-tion gave him confidence to enlist the co-opera-tion of a second capitalist, after the first had failed him, and of asking for an extension of his declining patent. Without this opportune help Watt could not have succeeded to mature his invention; he would, in all probability, have relapsed into the mere instrument-maker, with broken health and broken heart, and the invention of the steam-engine would not only been retarded for a generation or two, but its upon the coarser conceptions of Papin, Savory, and Newcomen.

THE GREAT WORKS OF THE YEAR .- In viewing the latest achievements of engineering sel ence, two works strike the imagination chiefly by their exceeding magnitude, and by the influence they are likely to exercise upon the traffic of the world. The first of these is the great Pacific Railway, which, in passing through vast regions hitherto inaccessible to civilized man, and over formidable mountain chains, joins Call fornia with the Atlantic States of the great American republic. The second is the Snez shipping canal, which, notwithstanding adverse prognostications and serious difficulties, will be opened very shortly to the commerce of the These works must greatly extend the range of commercial enterprise in the North Pacific and the Indian Seas. The new waterway to India will, owing to the difficult navigation of the Red Sea, be in effect only available for ships propelled by steam, and will give a stimulus to that branch of engineering.

Telegraph communication with America has been rendered more secure against interruption by the successful submersion of the French Transatlantic Cable. On the other hand, telegraphic communication with India still remains in a very unsatisfactory condition, owing to imperfect lines and divided administration. To supply a remedy for this public evil, the Indo-European Telegraph Company will shortly open its special lines for Indian correspondence. In Northern Russia, the construction of a land line is far advanced to connect St. Petersburg with the mouth of the Amoor river, on completion of which only a submarine link between the Amoor and San Francisco will be wanting to complete the girdle round the earth. With these great highways of speech once established, a network of submarine and aerial wires will soon follow, to bind all inhabited portions of our globe together into a closer community of interests, which, if followed up by steam communication by land and by sea, will open out a great and meritorious field for the activity of the civil and mechanical engineer.
WARFARE.—While the extension of commu-

nication occupies the attention of perhaps the greater number of our engineers, others : gaged upon weapons of offensive and defensive We have scarcely recovered our wonwarfare. der at the terrific destruction dealt by the Armstrong gun, the Whitworth bolt, or the stee barrel consolidated under Krapp's gigantic steam hammer, when we hear of a shield of such solidity and toughness as to bid defiance to them all. A larger gun, or a hard bolt by Palliser or Gruson, is the successful answer to this challenge, when again defensive plating, of greater tenseity to absorb the power residing in the shot, or of such imposing weight and hardness combined as to resist the projectile absolutely (causing it to be broken up by the force residing within itself), is brought forward. The ram of war with heavy iron sides, which a few years since was thought the most formidable, as it certainly was the most costly weapon ever devised, is already being superseded by vessels of the Captain type, as designed by Captain Coles, and ably carried out by Laird Brothers, with turrets (armed with guns of gigantic power) that resist the heaviest firing, both on account of their extraordinary thickness, and of the angular direction in which the shot is likely to strike. By an inc vice Captain Moncrieff lowers his gun upon its rocking carriage after firing, and thereby does away with embrasures (the weak place in protecting works), while at the same time he gains the advantage of reloading his gun in compara tive safety. It is presumed that in thus raising formidable engines of offensive and defensive warfare, the civilized nations of the earth will pause before putting them into carnest opera-tion, but if they should do so, it is consolatory to think that they could not work them for long without effecting the total exhaustion of their treasuries, already drained to the utmost in their

Refrigeration .- Although heat may be said to be the moving principle by which all things in nature are accomplished, an excess of it is not only hurtful to some of our processes, such as brewing, and destructive to our nutriments, but to those living in hot climates, or sitting in crowded rooms, an excess of temperature is fully as great a source of discomfort as excessive cold can be. Why, then, may I ask, should we not resort to refrigeration in summer as well as to calorification in winter, if it can be shown that the one can be done at nearly the same cost as the other? So long as we rely for refrigeration upou our ice cellars, or upon importation of ice from distant parts, we shall have to look upon refrigeration as a costly luxury only, but by the use of properly-constructed machines it will be possible, I believe, to produce refrigeration at an extremely moderate expenditure of fuel and labor, A machine has already been constructed capable of producing 9 pounds of lee or its equivalent for 1 pound of coal, whereas the equivalent values of positive heat developed in the combustion of 1 pound of coal, and of negative heat residing in 1 pound of icc, is about as 12,000 to 170, or as 1 to 70. This result already instifies the employment of refrigerating machines upon a large scale, but it is hard to say what practical results may yet be reached with an improved machine on strictly dynamical principles, because such a machine seems not tled in its results to any definite limits. In changing, for instance, a pound of water from the liquid into the gaseous state, a given num-ber of units of heat are required, that may be produced by combustion of coal or by the ex-penditure of force, but in changing the same pound of water into ice, heat is not lost, but gained in the operation, which heat must be traceable to another part of the machine, either as sensible heat or as developed force. It would lead me too far to enter at present into particulars on this question, which is one not without interest for the physicist and the mechanical

Wasted Con! Dust.

In Great Britain the quantity of coal dust remaining unemployed is calculated at 28,000,000 tons. Various methods have been attempted to convert it into useful fuel by compressing it into cakes, but the operation is not sufficiently remunerative. In Belgium they follow another plan, which seems to answer better. They mix coal dust with eight per cent. of tar, and then press it into cakes, which are found to make excellent fuel for steam engines.

Wave Power.

An engineer of New York proposes to employ the waves of the ocean as a motive power for running mills, factories, etc. His plan is to build on the beach (at Long Branch, Rockaway, or elsewhere) a dyke several hundred feet in length, against which the waves of old ocean are privileged to break as wildly as they will, but are not to be allowed to accede. In the sea face of the dyke are the openings of conduits which conduct the water to a reservoir within the dyke, A canal from the re- !

servoir reconducts the water, by a circuitous route, to the ocean, to turn on its way the wheels of as many mills as can be built on the canal banks.

A dog as surely apprehends the general idea of a tree, a man, a piece of meat, cold and heat, light and darkness, pleasure and pain, kindness, threatening, barking, run-ning, and so on through the whole range, limited as compared with ours, of matter within his ken, as if he had a word for each. He can as clearly form the intention, "I mean to steal that bone, if its owner turns his back and gives me a fair chance," as if he had said it to himself in good English. He can draw a complex syllogism, when applying to exi-gencies the results of past experience, and can determine, "That smoking water must be hot, and I shall take good care not to put my foot in it;" that is to say, "Water that smokes is hot; hot water hurts; this water is hot; rgo, it will hurt my foot,"-PROF. WHITNEY.

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