away, raised it to the height of the observatory, and carried it against the cast-iron column through which pass the connections between the top and the registering apparatus; destroying the same, and preventing further observation of the anemometer. Manila was in the centre of the greatest violence; at a short distance from the city, the barometer stood 3½ tenths higher.

Effects. — The typhoon was the most severe that has visited the islands for fifty years. Houses were unroofed, vessels driven ashore, whole villages prostrated, trees torn up by the roots; metal plates, tiles, timbers, and heavy weights were carried to great heights and distances. Millions of property were destroyed in the city and its suburbs; the growing cane and hemp in the provinces were seriously damaged, thousands of people are houseless and penniless, and general distress and business prostration are the result. The rain saturated every thing that the wind exposed; what was left, more or less injured, was further ruined by another typhoon of almost equal violence, which occurred Nov. 5.

SAMUEL KNEELAND.

CAPTAIN C. E. DUTTON ON THE HAWAIIANS.

CAPTAIN DUTTON of the United-States Army has just returned from a sojourn of seven months on the Hawaiian Islands, where he went for the purpose of studying the volcanic phenomena. Although most of his time was necessarily devoted to geological investigation, he yet found time to collect a large mass of ethnological data, which he presented in a most interesting form at a meeting of the Anthropological society of Washington, held Jan. 2.

He said that in color the inhabitants are of a bronze shade about midway between the color of the North-American Indian and the Malayan. The general features, however, are very unlike those of our Indians, and partake in part of the character of the European and in part of that of the African tribes, though more strongly of the former. In stature the Hawaiians are large, and equal the Anglo-Saxon race. There are, however, two broadly marked social castes, and these differ physically almost as widely as they do socially. The ruling class are lighter in color, and larger in stature, being usually above six feet in height, and sometimes reaching six feet seven inches. They also tend to obesity, and are readily distinguishable from the lower classes in numerous other ways. The Hawaiian Islanders belong to the finer and better of the two great races of men which about equally share the Polynesian Islands. They were never cannibals, and nothing offends them more than the charge of having eaten Captain Cook.

Many facts point to the East-Indian Archipelago as the portion of the globe from which these people originally came; and among these evidences are their possession, when first seen by Europeans, of the dog, the pig, and the domestic fowl, none of which could have come from America. Their language allies them very closely to certain Bornean tribes, and particularly to the Dyaks. This affinity is especially observable in their numerals.

Their legendary lore, which is amazingly rich, also belongs to the East-Indian type, and even partakes in a striking manner of the character of that of India, Western Asia, and Egypt. Their myth relating to the creation of woman is identical with that in Genesis, and may have been borrowed from the early missionaries; but against this view is the remarkable fact that it appears in an archaic form of their language which only the priesthood can fully understand. The present king Kalakaua is much interested in the ethnology of his people, and believes in their American origin, — a belief which the speaker did not share.

The population of the Hawaiian Islands is dense, and every thing points to the conclusion that this has been the case for a very long period. The arable lands are confined to belts around the islands extending inward from six to twelve miles to the beds of lava or steep sides of the mountains. These lands are divided up into very small lots by means of stone walls.

The state of society is by no means low or savage. Society is well organized according to a rigid system. This system very closely resembles the feudal system of European history, having all the classes which characterized that system. Prior to the consolidation of all the governments of the islands by Kamehameha I., in the early part of this century, there existed on each island a number of independent kingdoms. The kings were the proprietors of all lands, which they parcelled out to subordinate chiefs, whose tenure was strictly analogous to enfiefment, with this exception, that, in addition to homage and military service, tribute was also exacted of them. The latter subdivided their fiefs among their retainers on similar conditions, and these turned them over to the lowest, or working classes, to cultivate; which latter were the true *villeins*, who were merely tenants at will. Still this latter form of tenure was the most permanent; since the chiefs were liable to be changed by military reverses and royal displeasure, while the villeins remained, as in Europe, practically *adscripti glebae*. The priesthood was almost always found supporting the king. This class maintained, down to the reign of Kamehameha II., the most despotic sway over the people, and chiefly through the principle involved in the terrible word *tabu*. The fundamental idea underlying this term is *divine prohibition*, and the penalty for the breaking of a tabu was always death. The people submitted to this in the firm belief that death in some form was certain to follow such offences; and that, if man did not inflict it, the gods surely would. Tabus were either permanent, recurrent, or merely temporary and arbitrary. Among the permanently tabued acts was that of the sexes eating together. Special tabus were prescribed by the king, with the advice of the priesthood.

The speaker went on to describe in detail the mode of subdividing the land for agricultural purposes, the skill displayed in irrigation, the principal products of the soil, the leading articles of food and how they are prepared, the character of the houses, the manufacture of tappa-cloth and of mats out of the screw pine, the culinary utensils and dishes used; the implements manufactured and the materials yielded by the country for these purposes; the modes of fishing; the kind of dress worn; the elaborate robes, cloaks, helmets, etc., made for the kings, of yellow and red feathers; and the use of nuts as candles. He further treated of the military tactics of the Hawaiians, and the arms employed; of their

canoes, and mode of navigation, by which they have frequently visited the Society Islands, a distance of 2,400 miles. They knew much of astronomy, and possessed an accurate calendar, dividing their year into twelve months of thirty days, with allowance for the bissextile. Their year begins at the time when the Pleiades rise at sunset. They count to millions, with names for all their numbers. The priests know every plant on the islands, and are especially familiar with their toxic properties. Interesting remarks were made on their language, their mythology, and their religion. Legends and royal pedigrees are handed down with great exactness by a special class who make this their only business. The language of their classic lore is archaic, and unintelligible to the common people. The genealogy of kings is traced back a hundred generations. Descent is here in the male line, but descent of property among the other classes is in the female line. This is rendered necessary from the fact, that with the exception of the queen, who is *tabu* and therefore chaste, chastity in women is regarded as a disgrace, in that it denotes a want of attractions. Monogamy prevails, but divorce is easy and sexual morality excessively lax. The dead are buried in caves in the mountains, in a sitting posture. Until recently human sacrifices were of frequent occurrence. Criminals are executed secretly with a club. Walled enclosures constituted their "cities of refuge." Their temples in the form of parallelograms were also described.

Captain Dutton closed his remarks by rapidly glancing at the influence of the missionaries, and the modern innovations and modifications in Hawaiian society.

VARIATIONS IN THE VERTICAL DUE TO ELASTICITY OF THE EARTH'S SURFACE.

IN the Philosophical magazine for December, 1882, Mr. G. H. Darwin discusses this subject. He considers first the disturbance due to variations of barometric pressure; second, those due to the rise and fall of the tides. Mr. Darwin has previously investigated "the state of stress produced in the earth by the weight of a series of parallel mountains" of such shape that the equation to the outline of the section made by a plane traversing all the mountains and valleys perpendicularly is $x = -h \cos \frac{z}{b}$; the axis of x being supposed vertical, and that of z horizontal and perpendicular to the mountain chains.

Taking the origin in "the mean horizontal surface, which equally divides the mountains and valleys," and midway one of the mountains, and letting "a, γ, be the displacements at the point x, z, vertically downwards and horizontally," he finds, when $x = 0$,

$$a = \frac{g w h}{2 v} b \cos \frac{z}{b}, \quad \gamma = 0, \quad \frac{d a}{d z} = -\frac{g w h}{2 v} \sin \frac{z}{b}.$$

In these equations, w is "the density of the rocks of which the mountains are composed; g, gravity; v, modulus of rigidity."

If we suppose the region to have been originally a plane, such as would be formed by toppling over the upper half of each mountain into the neighboring valley, the quantity $\frac{d a}{d z}$ above is the present real inclination of what was originally the horizontal surface stratum.

The apparent inclination, however, as measured by means of the plumb-line, is something different from the above, owing to the change in the direction of the latter due to the changed distribution of the attracting masses about it. One of the most interesting portions of Mr. Darwin's present paper is the proof of a very simple ratio, for any such case as that now under consideration, between the deflection of the plumb-line and the slope $\frac{d a}{d z}$ of the stratum $x = 0$.

This relation, which was pointed out to Mr. Darwin by Sir William Thomson, though the proof here given is due to the former alone, is as follows: —

If δ be the earth's mean density, r the earth's radius, and v, g, as above, the deflection bears to slope the same ratio as $\frac{v}{g}$ to $\frac{1}{3} r \delta$. "This ratio is independent of the wave-length $2 \pi b$ of the undulating surface, of the position of the origin, and of the azimuth in the plane of the line normal to the ridges and valleys. Therefore the proposition is true of any combination whatever of harmonic undulations; and as any inequality may be built up of harmonic undulations, it is generally true of inequalities of any shape whatever." With rigidity as great as that of steel, the slope is $1\frac{1}{2}$ times as great as the deflection.

"In the problem of the mountains, $w h$ is the mass of a column of rock of one square centimetre in section, and of length equal to the height of the crests of the mountains above the mean horizontal plane. In the barometric problem, $w h$ must be taken as the mass of a column of mercury, of a square centimetre in section, and equal in height to a half of the maximum range of the barometer."

This maximum range is assumed to be 5 centimetres. The rigidity of the earth is supposed to be 3×10^8 million grammes per square centimetre, — greater than that of the most rigid glass. The distance from the region of high to that of low barometer is taken as 1,500 miles.

With these data, it is found "that the ground is 9 centimetres higher under the barometric depression than under the elevation."

The maximum slope of the surface, which is found midway between the regions of high and low barometer, is $0''.0117$; and for the maximum apparent deflection of the plumb-line, "this is augmented to $0''.0146$ when we include the true deflection due to the attraction of the air." [1]

In the problem of the tides, Mr. Darwin imagines, as before, "an infinite horizontal plane which bounds, in one direction, an infinite, incompressible, elastic solid." Upon this he lays off straight strips of equal and uniform width, representing alternately areas of land and of water. At full tide, the surface will be such that for it x will be a discontinuous periodic function of z. This function having been developed according to Fourier's theorem, the results of the previous investigations become applicable.

It is thus found that "midway in the ocean and on the land there are nodal lines, which always remain in the undisturbed surface," whether the tide be high or low on either coast; "that the land-regions remain very nearly flat, rotating about the nodal line, but with slight curvature near the coasts."

[1] Mr. Darwin remarks that this last result is independent of the wave-length of the barometric inequality, and so it appears from the formula. It would seem, however, that the above correction for the attraction of the air is only applicable when the wave-length is very considerable compared with the height of the effective atmosphere.

This apparent deflection is so great, that, with the deflections caused by the tides, Mr. Darwin concludes it will probably forever mask the lunar disturbance of the plumb-line, the amplitude of this latter disturbance being by calculation only $0''.0216$. This conclusion will probably put an end to the laborious and refined experiments which he and his brother have been conducting for two or three years in order to detect and measure the lunar action.