formation, were considered by the board as a whole to make transformation of this plan essentially not feasible.

Again, inasmuch as the canal would probably not be completed and opened within less than ten years on any plan the locks of the minority plan would not be large enough to accommodate ships then afloat if the rate of increase of ships' dimensions during the past ten years should be nearly reached during the next ten.

The time estimated by the majority to be required for the building of the sea-level canal is from twelve to thirteen years after making the most abundant allowances for the effects of climate, of the rainy seasons, of the necessary repairs and renewals of plant, of the eight-hour labor day, of the low efficiency of available labor, and without working more than one shift of labor within twenty-four hours. It is believed that the investigations of the majority show, however, that there is a reasonable probability of a sea-level canal being opened in from one to two years less time than their estimate.

The time estimated by the minority as necessary for the construction of their lock plan was ten to eleven years. As the construction of this plan involves a much higher grade of labor, and a far larger amount of so-called works of art, such as the locks, involving the making and putting in place of about 3,500,000 cubic yards of concrete, than the sea-level plan, the writer believes that a lock plan with a summit level eighty-five feet above mean tide can be executed in little if any less time than a sea-level plan.

The recent dreadful earthquake disaster at San Francisco constitutes the gravest warning in human experience of the advisability of constructing this canal in such a way as to give it the greatest degree of immunity from the results of any convulsion of nature. The isthmus of Panama is a region of rather frequent earthquakes, but they are not often severe. It would be an act of folly, however, to ignore the lesson of such an appalling catastrophe. The canal which is to be constructed across the Isthmus of Panama should be of such a type as to give the minimum of obstruction, either natural or artificial, the greatest degree of safety not only in operation, but from the effects of earthquakes, against the severity of which there is absolutely no insurance whatever, and the sea-level is the only type which fulfills these imperative requisites.

Wm. H. Burr.

SCIENTIFIC BOOKS.

Archeological Researches in Costa Rica. By C. V. Hartman. Stockholm, Ivar Haeggströms Boktryckeri, A.B., 1901. 4°, 195 pp., 488 text illus., 1 map and LXXXVII pls.

Museum collections and special publications derive their value from the character of the field-work on which they are based. It is with such material as Mr. Hartman has furnished and by means of the methods he employed that we may hope to raise American archeology to the dignity of a real science.

In the growth or decay of art, industry, customs, religion, there must of necessity enter the time element. For this reason, systems of relative chronology play a most important part in prehistoric archeology. A careful, intelligent, thorough study, therefore, of the contents of graves is absolutely indispensable. 'Archeological Researches in Costa Rica' is by no means confined to a study of burial places, yet it describes fully more than 400 graves.

Mr. Hartman's field investigations were carried on during the years 1896–97. He began his researches on the east coast with the great mound and walled enclosure at Mercedes. The mound is about 300 meters west of Rio Novillo; is truncated, with diameters at base and top of 30 and 20 meters, respectively. The height, 6.5 m., is the same as that of the surrounding wall. The purpose of the mound 'seems to have been to serve as a platform, or temple, for the large statues, which were

placed with faces towards the rising sun.' The author suggests that a wooden structure with thatched roof may have covered the mound, while the 'flat stone walls apparently only served for enclosures.' Four human figures and one of an alligator were found at the base of the large mound. A small mound at the end of the northern stone wall was also investigated, but neither it nor the large mound was completely explored.

In the thick forest near the enclosure there were graves that had previously been opened. They were all of an oval or rectangular shape. Only after careful search in the 'thorny thicket, beneath the gigantic forest trees' were hitherto undisturbed graves discovered. "They were arranged in small groups inside a common and almost circular platform, or enclosure, usually about half a meter in height." Each enclosure was bounded by a margin of stones of various sizes. The groups, each containing from three to five graves, are described. As regards construction the graves at Mercedes all belong to one class. The walls are still in perfect condition except when interfered with by the roots of trees. Partially chipped limestone slabs form roof and floor.

Only one grave contained traces of bone. In most of them pottery was found. "The majority of these vessels show signs of wear and are covered with soot proving that they were employed as cooking utensils." Other objects found were: Charred corn and corncobs, two stone celts and a bead of blue glass. This latter being of European manufacture, gives a clue to the age of the burials (not earlier than the sixteenth century). In these regions it has been the custom to bury the dead inside the houses, so that in all probability the low platform enclosures, containing the graves described, were primarily foundations for the huts of the living.

A curious discovery was made about 100 m. from the temple mound, where the 'rains had swept away the humus and uncovered a small portion of the roof of a stone chamber, containing a lot of pottery, but no proof that it had been used as a grave.' The construction of the chamber, which differed in several respects from the graves and the amount of pottery contained therein, leads the author to look upon it as a cache.

Not the least interesting find made in the neighborhood of Mercedes was a stone-cutter's workshop. It was discovered by chance while opening forest paths in search of graves. "Over a surface of some 20 square meters and to a depth of about one meter, the soil was intermingled with chips and partly finished idols."[1]

Rains making work on the Atlantic lowlands practically impossible the highland valleys of the interior were chosen as a field of exploration, but not before investigating a number of sites known to the occupants of the neighboring haciendas. These included a stone enclosure at Williamsburg and graves at Siquirres, Sta. Rosa, Guasimo and Jiminez.

As to work in the highlands, the valley of Cartago was selected as the most promising. Near Santiago, twelve stone cists and as many grave-pits were found in a flat elliptical mound, the cists being arranged in the eastern half and the pits in the western half. The latter differ in construction from the cists, being bowl-shaped and formed of cobblestones. The cists were all quadrangular, with 'roof, sides and bottom composed of thin slabs of limestone.' In both forms of grave, a number of objects, chiefly pottery, were found.

There were no traces of bones. The graves were not long enough to admit of adult burial at full length. It is presumed that these graves were used as repositories of the bones only after removal by decomposition or otherwise of the soft parts, a presumption strengthened by the fact that 'quite small stone cists were found in several places to contain remnants of skeletons, which had been apparently deposited in them in bundles.'

The vessels in the Santiago stone cists were, as a rule, well preserved; few bore marks of use. In fact only a few are large enough to admit of practical use. They are probably symbols of larger vessels. Later researches on

[1] It was for his work on the east coast that the Loubat prize was awarded to Mr. Hartman by the Swedish Academy of Literature, History and Antiquities.

the Pacific coast brought to light a quantity of diminutive mortuary vessels.

At Chircot, a suburb of Cartago, the ancient capital of Costa Rica, was found 'a really extensive ancient burial ground, which had been left almost undisturbed.' The superficial part only of the enclosing stone-circle had been removed by cultivators of the soil. Here were 'crowded together in a small oblong space' 20 meters long by 15 in breadth, 205 graves. They were arranged in three layers. The cists of the lower, or oldest, layer were in three groups; those of the middle layer, in four groups; while the cists of the top layer were fairly evenly distributed over the whole burial ground.

The Chircot cists were in shape like those at Santiago and many were diminutive in size. In most of the cists that were of sufficient length, the 'skeletons lay stretched out on their backs at full length.' In the small cists, the bones, when present, were in heaps or bundles and often did not represent the entire skeleton. The skulls were dolichocephalic.

The mortuary vessels were not always in the cists. Many were found just outside, usually at the head end and, in a few cases, on the roof. Of the relics deposited inside the cists, the majority were in the vicinity of the head and trunk; a few were near the feet.

Objects in stone were rare. Of large, crude vessels intended for household purposes, none were found; nor any object of European origin. While the burial place must have been in use a considerable length of time, there were no cultural differences between the graves and contents of the lowest layer of burials and those of the highest. A majority of the cists contained no relics at all. In each of the others from one to five were found.

About 50 meters east of the first burying-ground a second, somewhat smaller, was found. It had been, in part, demolished. The cists that remained were similar to those of the first field and arranged in two or three layers. In the small cists were 'fragments of skeletons deposited in bundles, usually one in each cist; but in some, two or three.'

At Los Limones, 6 kilometers from Cartago, two elliptical mounds were found. They were not more than a meter high at the center, and the stone margins, if they ever existed, had disappeared.

There were 26 cists in the first mound and 39 in the second. The graves were of the same construction as those at Chircot, and were, for the most part, without artifacts. Stone objects were especially rare.

Orosi, the next site investigated, is in the mountains some 10 kilometers southeast of Cartago. It is an ancient dwelling-place selected because of a desirable water supply and adjacent stone quarries. The general ground-plan shows a number of circles and semicircles, bordered by stones and varying in size from 8 or 10 to 20 meters in diameter. In the midst of these is a rectangular space 27 m. long by 17 broad, surrounded by low embankments—probably an open courtyard.

Five of the stone enclosures containing graves were excavated by Mr. Hartman. It was here he found an obsidian flake—'the only object of obsidian met with during all the excavations in the highlands.' Obsidian is also rare on the Pacific side, the author finding 'not even a single chip of obsidian' during his excavations there. One of the stone circles at Orosi was the richest in relics of any of the highland mounds.

About 1,000 stone objects were collected from a neighboring coffee plantation, where a number of partially demolished stone circles were still visible. In one of the cists opened, a golden bell was found; in another, two small tubes of rolled copper. Here stood, also, an upright stone slab with petroglyphs.

The volume represents the results of a year's scientific investigations carried on first along the Atlantic lowlands and later among the highlands of the interior. The culture is everywhere "that of a Stone Age people of high standing, possessed of ornaments of gold and copper, but with no tools or weapons of metal at all." No date can be fixed for the beginnings of this culture, but that it continued to exist after the arrival of the Spaniards is attested by the presence of glass beads in some of the graves.

Of native artifacts, only two implements of bone were found. The remainder were of

clay, stone or metal (gold and copper ornaments only). The great majority of the clay vessels were evidently intended for mortuary purposes only. They testify to a 'highly elaborated technique and cultivated taste,' but do not include any types that come up to the best there is in Chiriqui ceramics.

Two types of ornamentation are particularly noticeable: (1) Incised geometric designs; and (2) punctate knobs resembling raised tattoo marks, or scarifications. The author observes 'that certain classes of ornament seem to have been allotted to certain classes of vessels.'

The ancient Guëtares of Costa Rica seem to have excelled in the manufacture of large multicolored bowls, a number of which have been reproduced in color, thus adding attractiveness to what even without them would be a superb series of plates.

This large quarto volume is published at the sole expense of Mr. Åke Sjögren, who has also given the collection on a part of which the work is based, to the Royal Ethnological Museum in Stockholm.

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SCIENTIFIC JOURNALS AND ARTICLES.

The Botanical Gazette for June contains the following papers: K. M. Wiegand publishes an account of his researches on the conditions of buds and twigs in winter, his observations leading to many conclusions entirely in variance with accepted notions. S. Yamanouchi publishes a preliminary account of his investigation of the cytology of *Polysiphonia violacea,* showing definitely the alternation of generations. H. F. Weiss describes in detail the structure and development of the bark in sassafras. E. J. Hill gives an account of the distribution and habits of the common oaks of the Lake region.

WE learn from *The Botanical Gazette* that a new journal, bearing the title *Annales de Biologie Lacustre,* is to be published under the editorship of Dr. Ernest Rousseau, with the cooperation of a large board of editors. The first fascicle is announced to contain 192 pages, with figures and maps. Publication is to be in German, English, French and Italian. Each volume will contain 400 to 500 pages, and the subscription price will be twenty to thirty francs. The address of the editor is Musée Royal d'Histoire Naturelle, rue Vautier, 31, Brussels.

Science Progress, published from 1894 to 1898 under the editorship of Professor Bretland Farmer and the general direction of Sir Henry Burdett, has been revived under the name *Science Progress in the Twentieth Century.* The editors are Dr. N. H. Alcock, lecturer on physiology at St. Mary's Hospital Medical School, and Mr. W. G. Freeman, F.R.S. The journal is published quarterly by Mr. John Murray. The contents of the first number are as follows: 'A Science of Commerce and some Prolegomena,' by W. J. Ashley; 'Chloroform a Poison,' by B. J. Collingwood, 'Physical Geography as an Educational Subject,' by J. E. Marr; 'On the Occurrence of Prussic Acid and its Derivatives in Plants,' by T. A. Henry; 'The Solvent Action of Roots upon the Soil Particles,' by A. D. Hall; 'Some Notable Instances of the Distribution of Injurious Insects by Artificial Means,' by Fred. V. Theobald; 'The Blood-Platelets,' by G. A. Buckmaster; 'Some Recent Progress in Chemical and Structural Crystallography,' by A. E. H. Tutton; 'The Geological Plans of some Australian Mining Fields,' by J. W. Gregory; 'The Corn Smuts and their Propagation,' by T. Johnson; 'Nehemiah Grew and the Study of Plant Anatomy,' by Agnes Robertson; and 'The Utilization of Proteids in the Animal,' by F. G. Hopkins.

DISCUSSION AND CORRESPONDENCE.

DE VRIES AND HIS CRITICS.

THE followers of Darwin in the early sixties had two difficult tasks to accomplish. One was to induce people to give the theory of natural selection an unbiased consideration; the other, and more difficult one, was to get them to understand it.

"I have often found the most extraordinary difficulty," wrote Darwin to Carpenter,[1] "in making able men understand at what I was

[1] 'Life and Letters,' Vol. II., p. 18.