Photo by Underwood & Underwood

WATER GATES IN LOCK WALL

Through these gates the water is admitted to the great conduit in the center wall of the lock

wards erected and launched in the Pacific. Several years ago there were found in the jungle near Cruces two heavy anchors, with 14-foot shafts and weighing about 600 pounds which had been carried thus far on the way to the Pacific and there dropped and left to the kindly burial of the tropical jungle. When they were discovered a too loyal graduate of our military academy at West Point in charge of some engineering work on the Isthmus, thought it would be a fine thing to send them up there and have them preserved on the parade ground of the academy. Without announcing his intention he had them removed from the spot where they were found and had taken them as far as the steamship wharf at Colon when Col. Goethals—who has a habit of hearing of things that are not announced—quietly interfered. The anchors were removed to some safe spot and in due time will form part of the historic decorations of the new city of Balboa.

Doubtless by the standards of these days the wealth that was carried back and forth along the Royal Road by men crushed low like termite ants beneath their heavy burdens, was not great. Yet one gets some idea of the volume of the trade from Bancroft's statement that in the year 1624, just four years after the landing of the Mayflower, goods to the amount of 1,446,346 pesos d'oro (practically an equal number of dollars), were registered at the Casa, or custom house, while probably 7½ millions of dollars' worth of goods were smuggled through. There were great warehouses then and a stone church with a neighboring monastery to which it was customary to send the children of the richer people at Nombre de Dios to be kept until they had attained their seventh year. For that piously named town was almost a plague spot

Photo by Underwood & Underwood

THE LAKE ABOVE GATUN

and its miasmatic atmosphere was fatal to tender infants.

The paved trail echoes no more with the muleteer's cry, or the clatter of hoofs, nor are there wine shops to tempt the traveller for there are none to be tempted. But even in its palmiest days Cruces could have been but a dismal spot. Gage a soldier of fortune and an itinerant preacher visited the village in 1638 and left us this record:

"Before ten of the clock we got to Venta de Cruces where lived none but mulattoes and blackmores who belong unto the flat boates that merchandize to Portobel. There I had much good entertainment by the people who desired me to preach unto them the next Sabbath day and gave me twenty crownes for my sermon and procession. After five days of my abode there, the boats set out, which were much stopped in their passage down the river, for in some places we found the water very low, so that the boats ran upon the gravel; from whence with poles and the strength of the blackmores they were to be lifted off again".

HOW THEY GATHER AT THE RIVER

After the lapse of almost four centuries we found the shallows still there and the blackmores—or their descendants—ready to carry our boat past their fall. But the people who paid the early traveler twenty crowns for a sermon had vanished as irrevocably as the city's public edifices, and no descendants of like piety remain. Morgan's fierce raiders swept through the village in 1670, and its downfall may have begun then, for the stout Protestantism of the buccaneers manifested itself in burning Catholic churches and monasteries in intervals of the less pious, but more pleasing, occupation of robbing the Spaniards or torturing them to extort confessions of the hiding places of their wealth.

Sir Henry Morgan, however, was not the only famous man of battles to pass through Cruces. In 1852 a very quiet young captain in the army of the United States, one Ulysses S. Grant, was there in command of a company of the Fourth Regiment of Infantry, U. S. A., proceeding from New York to San Francisco. Cholera broke out among the men and the loss while on the Isthmus was heavy. At Cruces the men were detained for days, the roster of the sick growing daily, while rascally contractors who had agreed to furnish mules to the army sold them at higher prices to private parties eager to

WASHERWOMEN'S SHELTERS BY THE RIVER
For protection against the burning sun they erect small shanties of palms

get away from the pest hole. According to the surgeon's report the situation was saved by Grant, who made a new contract and enforced it—the latter being a practice that grew on him in later days.

For a brief space in the days of the gold rush to California in 1848–'54, Cruces bade fair to regain its early importance. Once the half-way place on the trail of Spaniards marching to steal gold from the Peruvians, and Englishmen following to rob and murder the robbers in turn, it became the meeting place of prospectors going out to California full of hope, and of miners returning, some laden with gold but more bowed with disappointment. Again Cruces became the point at which people and freights were transferred from the river to the trail, or vice versa. But another trail reached the river's bank at Gorgona and this village became a considerable rival to the older and larger place higher up stream. Here were several rambling wooden houses dignified by the name of hotels of which no trace remains today. The whole village, a considerable one in the spring of 1913, with a population of at least 3,000, is to be abandoned to the rising tide of Gatun Lake, and such portions of it as escape submergence by the water will be overwhelmed by the equally irresistible jungle.

Charles T. Bidwell, an English traveler who crossed the Isthmus in 1853 by way of the Gorgona route, says of the pleasures of a sojourn in that town, "The place contained a few stores and more drinking saloons, most of which were kept by the 'enterprising Yankee'. The Gorgona road to Panama was just then open, it being passable only in the dry season, and it was estimated that 2,000 persons had passed through this place on their way to or from California. * * * We decided to take the Gorgona road and arranged to have saddle mules ready in the morning to convey us to Panama for $20 each and to pay 16½ cents a pound additional for the conveyance of our luggage". (The distance now by rail, which closely follows the old trail is 16 miles, the fare 80 cents.) "We then went to inspect 'a free ball' which had been got up with all available splendor in honor of some feast, and

A FERRY ON THE UPPER CHAGRES

here we had a rare opportunity of seeing assembled many shades of color in the human face divine; a gorgeous display of native jewelry and not the most happy mixture of bright colors in the toilettes of those who claimed to be the 'fair sex'. Dancing however, and drinking too, seemed to be kept up with no lack of spirit and energy to the inharmonious combination of a fiddle and a drum; and those of the assembly whose tastes led them to quieter pursuits had the opportunity of losing at adjoining gaming tables the dollars they had so easily and quickly extracted from the travelers who had had occasion to avail themselves of their services. These tables too were kept by the enterprising Yankee. Having seen all this, and smoked out our cigars, we sought our beds, when we found for each a shelf or bunk in a room which our host boasted had at a push contained twenty-five or thirty people. * * * On awakening at daylight I found a basin and a pail of water set out in the open air on an old pianoforte, which some traveler had probably been tempted to bring thus far on the road".

Photo by W. T. Hoyer

THE MUCH PRIZED IGUANA

This lizard, which attains a length of five feet, is esteemed a delicacy in Panama

The writer goes on to say that it took a little over two days to traverse the distance to Panama, the guides having stolen the mules they had rented and made off during the night.

Above Cruces the banks of the Chagres begin to rise in perpendicular limestone cliffs, perhaps 60 or 70 feet high while from their crests the giant tropic trees, the wild fig, the Panama, the Ceiba and the sentinel rise yet another one hundred feet into the bright blue sky. Amongst them flash back and forth bright colored parrots and paroquets, kingfishers like those of our northern states, only gaudier, and swallows innumerable. Up and down the river fly heavy cormorants disturbed by the clank of the poles among the stones of the river bottom, but not too shy to come within 50 feet or so of our boat where, much to my satisfaction, there is no gun. White and blue herons stand statuesque in the shallows with now and then an aigret. Of life other than feathered one sees but little here. A few fish leaped, but though the river was crystalline and my guide assured me it was full of fish I saw none lurking in either deeps or shallows. Yet he must have been right for the natives make much of fish as an article of diet, catching them chiefly by night lines or the unsportsmanlike practice of dynamiting the stream, which has been prohibited by the Panama authorities, although the prohibition is but little enforced.

Now and then an alligator slips lazily from the shore into the stream but they are not as plentiful here as in the tidal waters of the lower river. Occasionally, too, a shrill cry from one of our boatmen, taken up by the other two at once, turns attention to the underbrush on the bank, where the ungainly form of an iguana is seen scuttling for

CRUCES—A LITTLE TOWN WITH A LONG HISTORY

safety. Ugliest of beasts is the iguana, a greenish, bulbous, pop-eyed crocodile, he serves as the best possible model for a dragon to be slain by some St. George. The Gila monster of Arizona is a veritable Venus of reptiles in comparison to him, and the devil fish could give him no lessons in repulsiveness. Yet the Panamanian loves him dearly as a dish. Let one scurry across the road, or, dropping from a bough, walk on the surface of a river—as they literally do—and every dark-skinned native in sight will set up such a shout as we may fancy rose from oldtime revellers when the boar's head was brought in for the Yuletide feast. Not more does the Mississippi darkey love his possum an' sweet 'taters, the Chinaman his bird's nest soup and watermelon seeds, the Frenchman his absinthe or the German his beer than does the Panamanian his iguana.

In a mild way the Chagres may lay claim to being a scenic stream, and perhaps in future days when the excellence of its climate in the winter becomes known in our United States, and the back waters of the lake have made its upper reaches navigable, excursion launches may ply above Cruces and almost to Alhajuela. Near the latter point is a spot which should become a shrine for Progressive Republican pilgrims. A low cliff of white limestone, swept clear of vegetation and polished by the river at high water describes an arc of a circle hollowed out by the swift river which rushes underneath. Springs on the bluff above have sent out little rivulets which trickling down the face of the stone have scarred it with parallel vertical grooves a foot or two apart. Seen from the further side of the stream it bears a startling likeness to a huge human upper jaw with glistening teeth. With a fine sense of the fitness of things the river men have named it "Boca del Roosevelt"—Roosevelt's mouth.

Some of the fluviograph stations are located far beyond the limits of the Canal Zone, but by the terms of the treaty with the Republic of Panama the Canal Commission has over such headwaters and reaches of the Chagres such jurisdiction as may be necessary for the protection and regulation of Gatun Lake. We went to one of these stations some 20 miles of poling up the Chagres beyond

A NATIVE CHARCOAL BURNER

Alhajuela. The keeper was a native of the Canary Islands who had mastered English sufficiently to make his reports over the 'phone. His wife, who greeted us in starched cotton with a pink hair ribbon, pink shoes and a wealth of silver ornaments, was a native, dark of complexion as a Jamaica negress, but her sister who was there on a visit was as white as a Caucasian. Doctors on the Zone say that these curious variations in type in the same family are so common that they can never foretell within several shades, the complexion of a baby about to be born.

THE NATIVES' AFTERNOON TEA

The keeper of this station was paid $65.50 monthly and the Commission supplied his house, which was of the native type and cost about $85. Though many children, pickaninnies, little Canaries or whatever clustered about his door, his living expenses were practically nothing. Expense for clothing began only when the youngsters had reached 11 or 12 years of age and thereafter was almost negligible—as indeed were the clothes. The river furnished fish, the jungle iguanas, wild pigs and birds; the little garden patch yams, bananas, mangoes and other fruits. He was far removed from the temptations of Matachin, or other riotous market places and he saved practically all of his pay. His ambition was to get enough to return to his native isles, buy a wine-shop and settle down to a leisurely old age—though no occupation could much outdo for laziness the task of watching for the rising of the Chagres in the dry season.

Returning from the upper waters of the Chagres one reaches Gatun Lake at Gamboa where the railway bridge crosses on seven stone piers. A little above is a fluviograph station fitted with a wire cable extending across the stream and carrying a car from which an observer may take measurements of the crest of any flood. Indeed the river is watched and measured to its very sources. It long ago proved itself unfit for trust, and one who has seen it in flood time, 40 feet higher than normal, bearing on its angry, tawny bosom houses, great trees, cayucas stolen from their owners, and dead animals, sweeping away bluffs at bends and rolling great boulders along its banks, will readily understand why the builders of the Canal stationed scouts and spies throughout the Chagres territory to send ample and early warning of its coming wrath.

Leaving the Chagres, turning into Gatun Lake and directing our course away from the dam and toward the Pacific end of the Canal, we traversed a broad and placid body of water interspersed with densely wooded islands, which very soon narrows to the normal width of the Canal. In midsummer, 1913, when the author conducted his inspection, a broad dyke at Bas Obispo cut off Gatun Lake and its waters from the Canal trench, then dry, which

PIERS OF THE ABANDONED PANAMA RAILWAY

here extends in an almost straight line, 300 feet wide, through steadily rising banks to the continental divide at Culebra. The railroad then crossed upon this dyke to the western side of the Canal and passed through several construction towns and villages, abandoned later when the Canal was filled and the railroad moved to the other side. Tourists with an eye for the spectacular used to stand on this dyke and speculate upon the thrilling sight when a huge blast of dynamite should rend the barrier, and in a mighty wave the waters of Gatun Lake should rush down the broad channel betwixt the eternal hills to make at last the long desired waterway from Orient to Occident. But unhappily Col. Goethals and his associates unsentimentally put the picturesque aside for the practical. No dynamite blast, no surging charge of waters through the cut, entered into their program. Instead with mighty siphons the water was to be lifted over the barrier and poured into the Canal for days until the two bodies of water were nearly at a level. Then by the prosaic use of floating dredges the dyke would be removed and the Canal opened from Gatun Locks to the locks at Pedro Miguel.

CHAPTER XII

THE CULEBRA CUT.

TECHNICALLY what is known as the Culebra Cut extends from Bas Obispo to the locks at Pedro Miguel, a distance of nine miles. To the general public understanding, however, the term applies only to the point of greatest excavation between Gold Hill and Contractor's Hill. But at Bas Obispo the walls of the Canal for the first time rise above the water level of Gatun Lake. At that point the cutting begins, the walls rising higher and higher, the Canal pressing stubbornly onward at a dead level, until the supreme height of the continental divide is attained at Gold Hill. Thenceforward on the line toward Panama City the hills grow lower until at the entrance to the locks at Pedro Miguel the banks sink practically to the water level. Out of this nine mile stretch there had been taken up to January 1, 1913, just 88,531,237 cubic yards of material and it was then estimated that there then remained to be excavated 5,351,419 cubic yards more. But the later estimate was destined to be largely increased for, after the date at which it was made, the number and extent of "slides" in the deepest part of the cut increased to staggering proportions. Col. D. D. Gaillard, Member of the Commission and Division Engineer in charge of the Culebra Cut, estimated in 1912 that in all 115,000,000 cubic yards would have to be removed.

WORKING ON THREE LEVELS

To the general public the slides seemed to menace the very existence and practicability of the Canal, though the engineers knew that they began even with the superficial excavating done by the French, and had therefore made allowance for them in their estimates. Not sufficient allowance however was made, and as month after month brought tidings of new slides, with terrifying details of such incidents as whole forests moving, vast cracks opening in the earth, large buildings in imminent danger of being swept into the Cut, the bottom of the Canal mysteriously rising ten to fifteen feet in the air, while smoke oozed from the pores of the adjacent earth—when such direful reports filled the newspapers the public became nervous, almost abandoning hope of the success of the great enterprise.

This attitude of apprehension on the part of the public is scarcely surprising. If the Capitol Park at Washington, with the National Capitol cresting it, should suddenly begin to move down into Pennsylvania Avenue at the rate of about three feet a day the authorities of the city would naturally feel some degree of annoyance. And if the smooth and level asphalt of that historic thoroughfare should, over night, rise up into the air 18 feet in spots those responsible for traffic might not unreasonably be somewhat worried.

Such a phenomenon would not be so startling in mere magnitude as the slides which added so greatly to the work of the engineers on the Canal, and made tourists, wise with the ripe fruits of five days' observation, wag their heads knowingly when Col.

Courtesy of Scientific American

THE ORIGINAL CULEBRA SLIDE

A Y. M. C. A. club had to be moved to escape this slide which in 1913 was still moving

Goethals calmly repeated his assertion that the water would be turned in by August. The Colonel, however, had not withdrawn or even modified this prophecy so late as June 10, 1913. Despite the almost daily news of increased activity of the slides he clung with tenacity to his purpose of putting a ship through in October.

If these slides were an entirely new and unexpected development for which no allowance of either time or money had been made in the estimates of the Canal builders they would of course justify the apprehension they have awakened in the non-professional mind. But the slides were in fact anticipated. The first slide recorded during our work on the Isthmus was in 1905; the others have only been bigger, and have been bigger only because the Canal being dug deeper has weakened the bases of even bigger hills along the banks. All the same, the proportions of the slides are terrifying and the chief geologist declared that they would not cease until the angle of the Canal bank became so gentle that gravity would not pull the crest down.

The slides are of two sorts. The simpler is a mere swift rush of all the loose surface dirt, sand, gravel and stone down the surface of the bank. These gravity slides, mere dirt avalanches, though troublesome, present no new problems. To stop them it is necessary only to carry the crest of the bank further back so that the angle will be less steep. But the great, troublesome slides are those caused by the pressure of the hill-top on its undermined and weakened base. These originate at the top of the hill, making their presence known by gaping fissures opening in the earth and extending in lines roughly parallel to the Canal. Once started the whole mass, acres in extent, moves slowly toward the cavity of the Canal, three feet a day being its swiftest recorded progress. At Culebra the slides compelled the moving of a large part of the town away from the edge of the Cut, lest it be swept into the gorge. The Culebra Y. M. C. A. clubhouse, the largest on the Zone had to be torn down to escape this peril.

As the slide moves slowly downward, its colossal weight applied at points where nature had made no provision for it, forces the earth upward at the point where it can offer the least resistance, namely the bed of the Canal. Sometimes this upheaval, so mysterious to the non-technical mind, attains a height of eighteen feet. Again, the friction of this huge mass of stone and gravel creates heat, which turns into steam the rills of water that everywhere

percolates through the soil. The upheaval of the Canal bed, and the occasional outpourings of steam have led at times to exaggerated and wholly unfounded reports in the newspapers of volcanic action being one of the new problems with which the Canal builders had to grapple.

The story told about the extent of the slides is sufficiently alarming, but the calmness with which Col. Goethals and his lieutenants meet the situation is reassuring. According to the official report there were twenty-six slides and breaks in Culebra Cut to January 1, 1913 with a total area of 225 acres. Since that date many others have occured. It is estimated that because of slides between 21,000,000 and 22,000,000 cubic yards of material in excess of the original estimate will have been taken out of the Cut before completion. This is just about one-fifth of the total amount of excavation, dry and wet, estimated originally for the whole Canal. But the attitude of the engineers toward this addition to their labors was merely one of calm acceptance of the inevitable and a dogged determination to get the stuff out of the way. The slides were an obstacle; so was the whole isthmus for that matter. But all that was necessary was to keep the shovels working and the slides would be removed and the isthmus pierced.

To my mind one of the finest evidences of the spirit animating the Canal force was the fashion in which this problem of the slides has been approached. It was at first disappointing, almost demoralizing, to find over night the work of weeks undone and the day when "finis" could be written to the volume put far over into the future. But the only effect was a tighter grip on the pick and the shovel, a new determination to force through the Canal. Culebra was approached as Grant approached Vicksburg. To reduce it and to open the Canal to traffic, as Grant opened the Mississippi to the steamboats of the nation, took more time than was at first expected, but it had to be done. The dirt could not always slide in faster than it could be carted out, for in time there would be no dirt left to slide. And so, undismayed and intent upon success, the whole force from Col. Goethals to the youngest engineer moved on Culebra and the doom of that stubborn block to progress was sealed.

To the unscientific mind the slides are terrifying

SLIDE ON WEST BANK OF THE CANAL NEAR CULEBRA

Picture shows about 1,000,000 cubic yards of material moving toward the cut at about three yards a day

ATTACKING THE CUCARACHA SLIDE

This slide has filled the Cut from side to side. A partial Cut has been dug through its center and the shovels are seen working on either side. The tracks are moved nightly as the material is removed.

in their magnitude and in the evidence they give of irresistible force. Man can no more check their advance than he can that of a glacier which in a way they resemble. When I was on the Isthmus the great Cucaracha slide was in progress, and had been for that matter since 1907. It had a total area of 47 acres and extended up the east bank of the Canal for about 1900 feet from the axis of the Canal. When it began its progress was disconcertingly rapid. Its base, foot, or "toe"—these anatomical terms in engineering are sometimes perplexing—moved across the canal bed at the rate of 14 feet a day. All that stood in its path was buried, torn to pieces or carried along with the resistless glacier of mud. Not content with filling the Canal from one side to the other, the dirt rose on the further side to a height of about 30 feet. Not only was the work of months obliterated, but work was laid out for years to come. Indeed in 1913 they were still digging at the Cucaracha slide and the end was not in sight. This slide was wholly a gravity slide, caused by a mass of earth slipping on the inclined surface of some smooth and slippery material like clay on which it rests. The nature of the phenomenon is clearly shown by the diagram printed on the next page in which the slide marked C is of the type just described.

On the west bank of the Canal occurred a slide of the second type caused by the crushing and squeezing out of underlying layers of soft material by the prodigious pressure of the high banks left untouched by the steam shovels. This slide is usually accompanied by the uprising of the bed of the Canal sometimes to a height of thirty feet. Col. Gaillard tells of standing on the bed of the Canal, observing the working of a steam shovel, when it gradually dawned upon him that he was no longer on the level of the shovel. At first he thought that the shovel must have been placed upon a bit of boggy land and was slowly sinking, but on investigation he discovered that the point on which he was standing had been slowly rising until within five minutes he had been lifted six feet without jar and with no sensation of motion. A perfectly simple illustration of the way in which this elevation of the bed of the Canal

is caused may be obtained by pressing the hand upon a pan of dough. The dough will of course rise at the side of the hand. On the "big job" the towering hills furnished the pressure, the bed of the Canal rose like the dough. In the diagram already referred to, the slide to the right marked "B" is of the type here described. To cope with it, the work of the shovels and dirt trains in the Canal carrying the débris away is supplemented by others above removing the crest of the slide and thus lightening the pressure. In the diagram shovels are shown thus working on two levels, but I have seen four terraces of the same slide bearing steam shovels and rumbling dirt trains hurrying the débris away to where it will no longer be a menace.

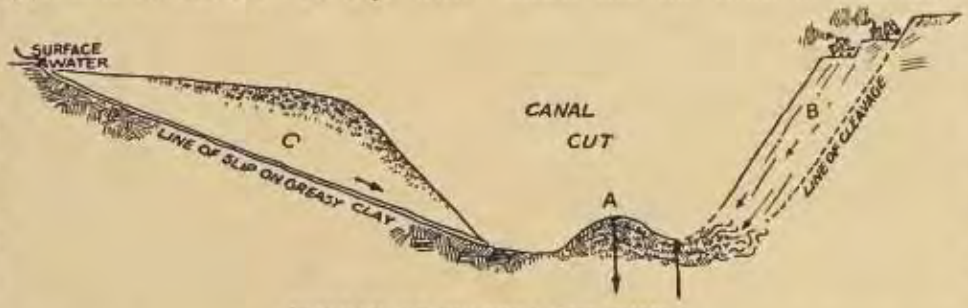

DIAGRAM OF CULEBRA CUT SLIDES

C. is a slide moving over a slippery surface; the mass B breaks on a line of cleavage and crushes the underlying material, forcing it up at A. The steam shovels are working to reduce pressure on B

The Culebra slide possessed a certain remorselessness which was not manifested by any of the others in quite so picturesque a way. For this slide, with apparently human malice, attacked not only the work done on the Canal proper, but like a well directed army moved on the headquarters of its foe. Its first manifestation appeared in the form of a wide crack in the earth at the crest of the hill on which sits the town of Culebra, and directly in front of the building used by Col. Gaillard as division headquarters for the engineers. Retreat was the only course possible in the face of such an enemy and the building was sacrificed. The Culebra Y. M. C. A. clubhouse too was a point of attack for the remorseless foe. It stood on the very crest of the hill, a beautiful building on a most beautiful site. The serpent of Culebra Cut—the word "culebra" means snake—saw this pleasant place of rest and marked it for his own. Nothing remained but to rally a force of men and tear the

Courtesy of Scientific American

A ROCK SLIDE NEAR EMPIRE

About 400,000 cubic yards of rock broke away, half filling the cut and opening it to the water of the Obispo Diversion Canal

THE AUTHOR AT CULEBRA CUT

building down for reërection at some other point. It was probably the largest and most attractive clubhouse on the Zone, but where it once stood there was a nearly sheer drop of about sixty feet, when first I visited the scene of the slide. Before the spot, too, on which the engineering headquarters had stood, there was a patch of lawn that had slid some eighty feet down into the Cut. With it traveled along a young eucalyptus tree waving its leaves defiantly in the face of the enemy that was bearing it to irrevocable disaster. Whether the Culebra slide had attained its fullest proportions in 1913 could not be told with certainty though the belief was current that it had. While the crest of the hill had not been fully reached, the top of the slide began at the edge of a sort of jog or terrace that extended away from the Cut some distance on a level before the ground began to slope upward again. Should it extend further a very considerable and beautiful part of the town would be destroyed, but as it is to be abandoned in any event on the completion of the Canal, this phase of the matter does not give the Commission much concern.

A third slide, of lesser proportions which seriously complicated the work of the engineers, occurred near Empire in August, 1912. Here about 400,000 cubic yards of rock slipped into the Cut, wrecking cars, destroying tracks and machinery and flooding the Canal with water from the Obispo diversion. It is not generally known that parallel to the Canal at various points are dug smaller canals, or big ditches, for the purpose of catching and carrying off the heavy annual rainfall on the canal watershed. These diversion ditches cost much in time and labor. One was constructed by the French. Another, 5¼ miles long, known as the Obispo diversion, cost $1,250,000 and was absolutely essential to the construction of the Canal. The rock slide, above referred to, broke down the barrier between the Canal cut and the diversion ditch and filled the former with an untimely flood which it took time to stay and pump out.

From all parts of the United States citizens interested in the progress of the Canal—and only those at the work can tell how widespread and patriotic that interest is—have sent suggestions for checking these slides. Practically all have been impracticable—a few only indeed have been thought worthy of being put to the test. One that for a time seemed worth trying was the suggestion that the wall of the cut be plastered with concrete, binding its surface together in a solid mass. But upon that being done it was demonstrated that the slides were not superficial but basic, and concrete face and all went down to one general destruction when the movement began. One curious

CUTTING AT BASE OF CONTRACTORS HILL
This shows the point at which the Cut is deepest. The actual level of canal bed was not reached at the time this photograph was taken

fact about the slides is that they do not invariably slide *down* throughout their entire course. Occasionally they take a turn upward. One tree at Cucaracha was pointed out to me which after moving majestically down for a space was carried upward over a slope for 100 feet, and then having passed the crest of the hill started down again.

A ROCK SLIDE AT LAS CASCADES
A steam shovel was wholly demolished but its operators escaped. The slides have seldom cost lives

The slides are by no means wholly in the wet season despite the popular impression to that effect, though it was in the height of that season that the one at Cucaracha began. Yet I have seen a slide moving slowly in January when the shovels digging fiercely at its base were enshrouded in clouds of dust. Curiously enough though tracks have been torn up, machinery engulfed and wrung into indistinguishable tangles of steel, no man was caught in any of these avalanches prior to May, 1913, when three were thus lost. The tax they have put upon time and labor however has been heavy enough. Within the $8^{4}/_{5}$ miles of the Culebra Cut fully 200 miles of track have been covered up, destroyed or necessarily rebuilt because of slides, and at one point tracks had to be maintained for nearly two years on ground moving from three or four inches to several feet a day. Of course this necessitated the constant work of repair gangs and track layers. When the Canal is completed nearly 22% of the excavation will have been of material put in the way by slides—a fact which seems to give some belated support to the prophecy of the early Spanish theologians that God would not permit the Isthmus to be pierced, but would array new and unexpected forces against so blasphemous an effort to interfere with His perfect work.

One feature of the slides which would surely have awed the pious prophets of the Spanish day, and which did indeed considerably perplex our more prosaic engineers, was the little wisps of smoke that arose from the slowly moving soil. That this was volcanic few believed, except some newspaper correspondents in eager search for sensations. The true explanation that heat generated by friction working upon the water in the earth caused the steam was all very well and complete as an explanation of that particular phenomenon. But it left a

Once a steam shovel taking its accustomed bite of four or five cubic yards of dirt, engulfed at the same time about a bushel of dynamite left from the French days. Again the teeth of a shovel bit upon the fulminate cap of a forgotten charge. In both these cases the miraculous happened and no explosion occurred. When one reads in the Official Handbook issued by the Commission that a pound of dynamite has been used to about every two cubic yards of material blasted, and compares it with the total excavation of about 200,000,000 cubic yards one thinks that even the undoubted sins of the Isthmus during its riotous days are expiated by such a vigorous blowing up.

HANDLING ROCK IN ANCON QUARRY

One day at Matachin an engineer with whom I was talking called a Spaniard and sent him off on an errand. I noticed the man walked queerly and commented on it. "It's a wonder that fellow walks at all", said my friend with a laugh. "He was sitting on a ledge once when a blast below went off prematurely and Miguel, with three or four other men, and a few tons of rock, dirt and other débris went up into the air. He was literally blown at least 80 feet high. The other men were killed, but we found signs of life in him and shipped him to the hospital where he stayed nearly eight months. I'd hesitate to tell you how many bones were broken, but I think the spine was the only one not fractured and that was dislocated. His job is safe for the rest of his life. He loves to tell about it. Wait 'till he gets back and I'll ask him".

JAMAICANS OPERATING A COMPRESSED AIR DRILL

Presently Miguel returned, sideways like a crab, but with agility all the same. "Tell the gentleman how it feels to be blown up", said the engineer.

"Caramba! I seet on ze aidge of ze cut, smoke my pipe, watch ze work when—Boom! I fly up in air, up, up! I stop. It seem I stop long time. I see ozzair sings fly up past me. I start down—I breathe smoke, sand. Bang! I hit ground. When I wake I in bed at hospital. Can't move. Same as dead"!

"Miguel never fails to lay stress on the time he stopped before beginning his descent", comments my friend, "and on the calmness with which he viewed the prospect, particularly the other things

going up. His chief sorrow is that no moving picture man took the incident".

Incidents of heroic self-sacrifice are not unknown among the dynamite handlers. Here is the story of Angel Alvarez, an humble worker on the Big Job. He was getting ready a surface blast of dynamite and all around him men were working in calm assurance that he would notify them before the explosion. Happening to glance up he saw a great boulder just starting to slip down the cut into the pit where he stood with two open boxes of dynamite. He knew that disaster impended. He could have jumped from the pit and run, saving himself but sacrificing his comrades. Instead he shouted a frantic warning, and seizing the two boxes of dynamite thrust them aside out of the way of the falling boulder. There was no hope for him. The rock would have crushed him in any event. But one stick of dynamite fell from one of the boxes and was exploded—though the colossal explosion that might have occurred was averted. They thought that Alvarez was broken to bits when they gathered him up, but the surgeons patched him up, and made a kind of a man out of him. Not very shapely or vigorous is Angel Alvarez now but in a sense he carries the lives of twenty men he saved in that moment of swift decision.

The visitor to the Cut during the period of construction found two types of drills, the tripod and the well, busily preparing the chambers for the reception of the dynamite. Of the former there were 221 in use, of the latter 156. With this battery over 90 miles of holes have been excavated in a month, each hole being about 27 feet deep. The drills are operated by compressed air supplied from a main running the length of the Cut and are in batteries of three to eight manned by Jamaica negroes who look as if the business of standing by and watching the drill automatically eat its way into the rock heartily agreed with their conception of the right sort of work.

He who did not see the Culebra Cut during the mighty work of excavation missed one of the great spectacles of the ages—a sight that at no other time, or place was, or will be, given to man to see. How it was best seen many visits left me unable to determine. From its crest on a working day you looked down upon a mighty rift in the earth's crust, at the base of which pigmy engines and ant-like forms were rushing to and fro without seeming plan or reason. Through the murky atmosphere strange sounds rose up and smote the ear of the onlooker with resounding clamor. He heard the strident clink, clink of the drills eating their way into the rock; the shrill whistles of the locomotives giving warning of some small blast, for the great charges

IN THE CUCARACHA SLIDE

were set off out of working hours when the Cut was empty; the constant and uninterrupted rumble that told of the dirt trains ever plying over the crowded tracks; the heavy crash that accompanied the dumping of a six-ton boulder onto a flat car; the clanking of chains and the creaking of machinery as the arms of the steam shovels swung around looking for another load; the cries of men, and the booming of blasts. Collectively the sounds were harsh, deafening, brutal such as we might fancy would arise from hell were the lid of that place of fire and torment to be lifted.

But individually each sound betokened useful work and service in the cause of man and progress as truly as could the musical tinkle of cow bells, the murmur of water over a village millwheel, or the rude melody of the sailors' songs as they trim the yards for the voyage to the distant isles of spice. The hum of industry that the poets have loved to tell about loses nothing of its significance when from a hum it rises to a roar. Only not all the poets can catch the meaning of its new note.

So much for the sounds of the Culebra Cut on a work day. The sights are yet more wonderful. One who has looked upon the Grand Canyon of the Colorado will find in this man-made gash in the hills something of the riot of color that characterizes that greatest of natural wonders, but he who has had no such preparation will stand amazed before the barbaric wealth of hues which blaze forth from these precipitous walls. Reds predominate—red of as deep a crimson as though Mother Earth's bosom thus cruelly slashed and scarred was giving up its very life's blood; red shading into orange, tropical, hot, riotous, pulsing like the life of the old Isthmus that is being carved away to make place for the new; red, pale, pinkish, shading down almost to rose color as delicate as the hue on a maiden's cheek, typifying perhaps the first blush of the bride in the wedding of the Atlantic to the Pacific. Yellow too from the brightest orange to the palest ochre, and blue from the shade of indigo which Columbus hoped to bring across this very Isthmus from the bazaars of Cathay; purple as royal as Ferdinand and Isabella ever wore, or the paler shades of the tropic sky are there. As you look upon the dazzling array strung out before you for miles you may reflect that imbedded in those parti-

BROW OF GOLD HILL, CULEBRA CUT

colored rocks and clays are semi-precious stones of varied shades and sorts—beryls, moss agates, bloodstones, moonstones which the workmen pick up and sell to rude lapidaries who cut and sell them to tourists. But in all this colossal tearing up of the earth's surface there has been found none of the gold for which the first white men lusted, nor any precious stone or useful mineral whatsoever.

Again I looked on the Cut from above one morning before the breeze that blows across the Isthmus from nine o'clock in the morning until sundown, had driven out of it the mists of early dawn. From unseen depths filled with billowy vapor rose the clatter of strenuous toil by men and machines, softened somewhat by the fleecy material through which they penetrated. Of the workers no sign appeared until the growing heat of the sun and the freshening breeze began to sweep the Cut clear in its higher reaches, and there on the topmost terrace of Gold Hill, half a mile across the abyss from where I stood, was revealed a monster steam shovel digging away at the crest of the hill to lighten the weight that was crowding acres upon acres of broken soil into the canal below. It seemed like a mechanical device on some gigantic stage, as with noiseless

"EVERY BITE RECORDED AT HEADQUARTERS"

ferocity it burrowed into the hillside, then shaking and trembling with the effort swung back its long arm and disgorged its huge mouthful on the waiting flat cars. The curtain of mist was slowly disappearing. From my lofty eyrie on an outjutting point of Contractor's Hill it seemed as if the stage was being displayed, not by the lifting of a curtain, but rather by the withdrawal of a shield downward so that the higher scenery became first visible. One by one the terraces cut into the lofty hillsides were exposed to view, each with its line of tugging steam shovels and its rows of motionless empty cars, or rolling filled ones rumbling away to the distant dump. Now and again a sudden eruption of stones and dirt above the shield of fog followed in a few seconds by a dull boom told of some blast. So dense was the mist that one marvelled how in that narrow lane below, filled with railroad tracks, and with busy trains rushing back and forth men could work save at imminent danger of disaster. Death lurked there at all times and the gray covering of fog was more than once in the truest sense a pall for some poor mutilated human frame.

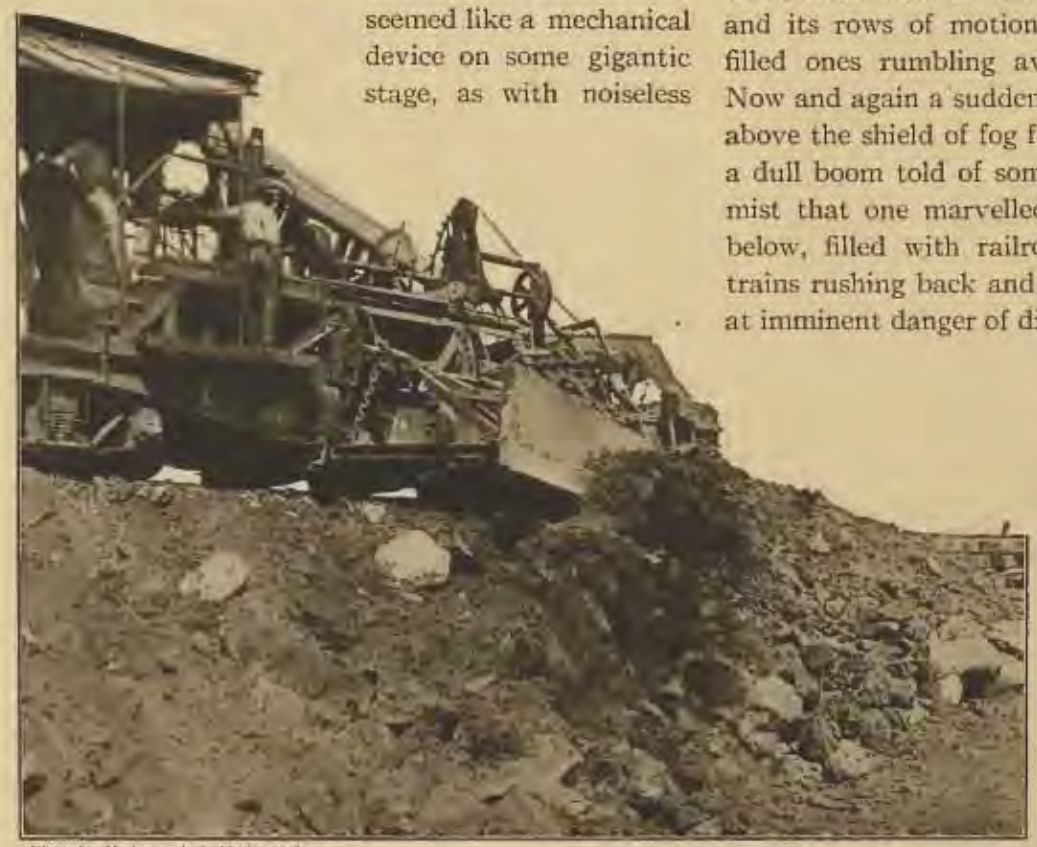

Photo by Underwood & Underwood

A DIRT-SPREADER AT WORK

Perhaps the most impressive view of the Cut in the days of its activity was that from above. It was the one which gave the broadest general sense of the prodigious proportions of the work. But a more terrifying one, as well as a more

your head with a five-ton boulder insecurely balanced, or a big, black Jamaican a few yards ahead perfunctorily waving a red flag in token that a "dobe" blast is to be fired. A "dobe" blast is regarded with contempt by the fellows who explode a few tons of dynamite at a time and demolish a whole hillside, but the "dobes" throw fifty to one hundred pound stones about in a reckless way that compels unprofessional respect. They tell a story on the Zone of a negro who, not thinking himself in range, was sitting on a box of dynamite calmly smoking a cigarette. A heavy stone dropped squarely on his head killing him instantly, but was sufficiently deflected by the hardness of the Ethiopian skull to miss the box on which the victim sat.

ONE OF THE COLONEL'S TROUBLES

This shovel was overwhelmed by a slide. The accident is not uncommon

Had it been otherwise the neighboring landscape and its population would have been materially changed.

It is no wonder that we have trains to dodge during the course of our stroll. There are at the moment of our visit 115 locomotives and 2000 cars in service in the Cut. About 160 loaded trains go out daily, and, of course about 160 return empty. Three hundred and twenty trains in the eight-hour day, with two hours' intermission at noon, means almost one train a minute speeding through a right of way 300 feet wide and much cluttered up with shovels, drills and other machinery. In March, 1911, the record month, these trains handled 1,728,748 cubic yards of material, carrying all to the dumps which average 12 miles distant, the farthest one being

Photo by Underwood & Underwood

THE SLICED-OFF HILL AT ANCON

lever and they close. A third lever causes the arm to swing until it comes to a stop above the flat car, then with a roar and a clatter the whole load is dumped. Perhaps then the trouble is just beginning. Once in a while a boulder of irregular shape rolls about threatening to fall to the ground. With almost human intelligence the great rigid arm of the shovel follows it, checking it as it approaches the edge of the car, pushing it back, buttressing it with other stones, so that when the train gets under way it may by no chance fall off. Sometimes you see all this done from a point at which the directing man is invisible and the effect is uncanny.

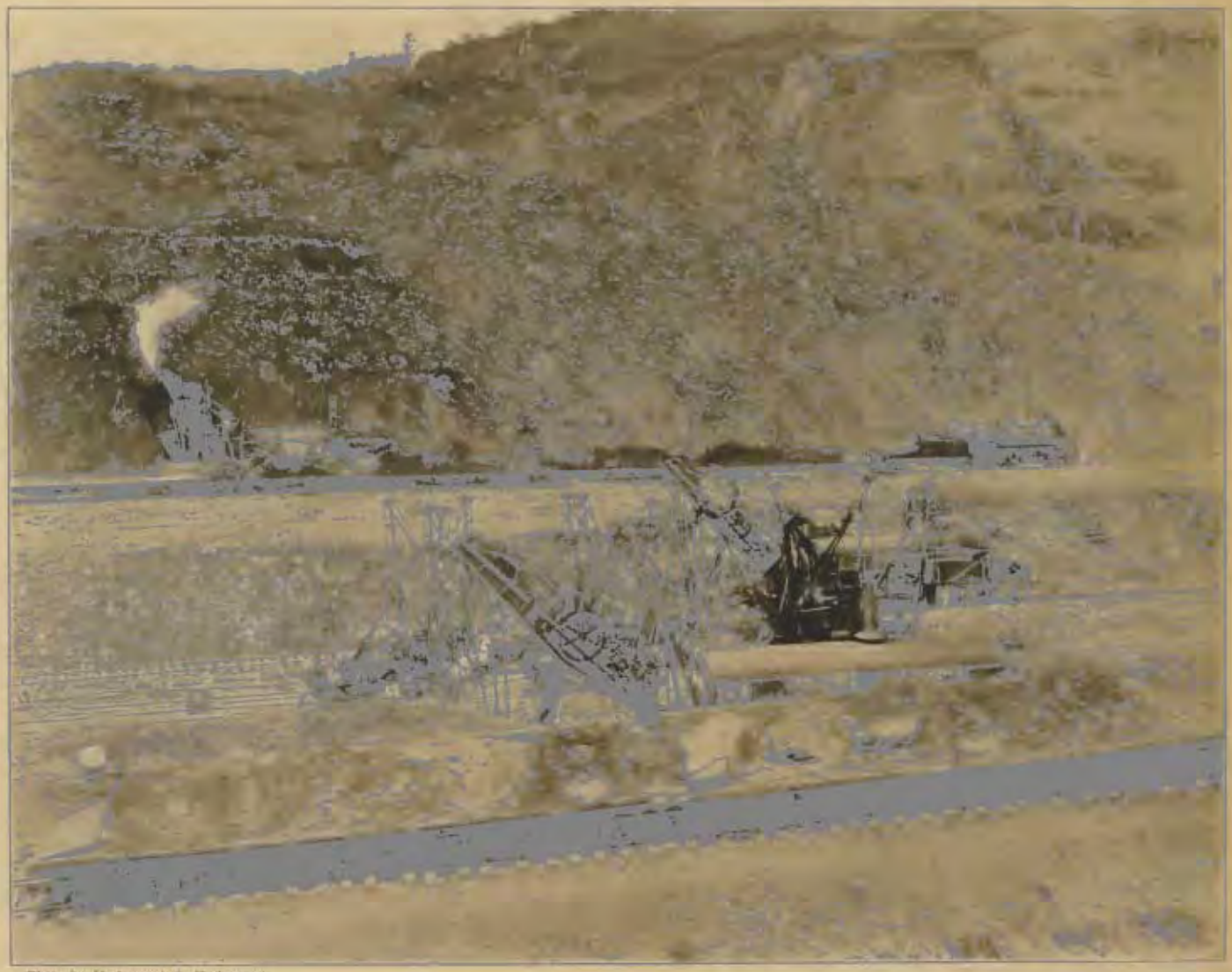

Photo by Underwood & Underwood

UNGAINLY MONSTERS OF STEEL WORKING WITH HUMAN SKILL

Travelers in Burmah are fond of telling how the trained elephants pile teak lumber, pushing with tusk and pulling with trunk until the beams lie level and parallel to an inch. But marvelous as is the delicacy with which the unwieldy animals perform their work, it is outdone by the miraculous ingenuity with which the inventive mind of man has adapted these monsters of steel to their appointed task. We shall see on the Zone many mechanical marvels, but to my mind the sight of a man, seated placidly in a comfortable chair, and with a touch on levers making a twenty foot steel arm, with a pair of scoops each as big as a hogshead at the end, feel up and down a bit of land until it comes upon a boulder weighing five tons, then pick it up, deposit it on a flat car, and block it around with smaller

THE CULEBRA CUT

Dazzling colors combined with its colossal proportions make this man-made gash in nature's eternal hills a magnificent spectacle. Its fullest glory will soon be dimmed, for the tropic jungle will cover its brilliant hues with a robe of green.

BUILDING AN UPPER TIER OF LOCKS

stones to hold it firm—this spectacle I think will rank with any as an illustration of mechanical genius. It is a pity old Archimedes, who professed himself able to move the world with a lever if he could only find a place for his fulcrum, could not sit a while in the chair of an Isthmian steam shoveler. These men earn from $210 to $240 a month and are the aristocracy of the mechanical force in a society where everybody is frankly graded according to his earnings. They say their work is exceedingly hard upon the nerves, a statement which I can readily credit after watching them at it. Once in a great while they deposit the six-ton load of a shovel on top of some laborer's head. Incidents of this sort are wearing on their nerves and also upon the physique of the individual upon whom the burden has been laid. On several occasions I timed steam shovels working in the Cut on various sorts of material and found the period occupied in getting a load, depositing it on the car and getting back into position for another bite to be a fraction less than two minutes. According to my observations from five to eight shovel loads filled a car. The car once filled, a big negro wig-wagged the tidings to the engineer who pulled the train ahead the length of one car. The Jamaica negro wig-wagging is always a pleasing spectacle. He seems to enjoy a job as flagman which gives from five to fifteen minutes of calm reflection to each one minute of wagging. Far be it from me to question the industry of these sable Britons by whom the Canal is being built. Their worth in any place, except that of waiters at the Tivoli Hotel, must be conceded. But their specialty is undoubt-

TRAVELING CRANES THAT BEAR THE BRUNT OF BURDEN CARRYING