we steam for the next four miles through a channel 45 feet deep and 800 feet wide, to Juan Grande, where the channel reduces in width to 500 feet, at which width it continues for the next 4¾ miles to Obispo. By this time the lake has narrowed to an average width of about three-fourths of a mile, and the valley of the Chagres turns from an easterly to a northerly direction, the lake backing up through the valley for a further distance of six or seven miles.

Control of Chagres Floods.—At this point is Gamboa, which was selected for the construction of a dam 180 feet high, should it have been determined to build a canal at sea level. At the surface of the water the distance between the abutting hills on either side of the lake is about 1,500 feet, and the depth of the lake through the outlet is about 35 feet. To such a high level has the great dam at Gatun raised the Chagres waters, that the rushing floods of the river have been entirely shorn of their peril. The backing of the lake seven miles up the valley, beyond the point at which the original course of the river intersects the canal, entirely relieves the canal authorities from any anxiety on account of the enormous floods which pour down the valley of the Chagres in the sudden and heavy rain storms. The rushing river spreads out quickly into the ever-widening area of the lake, and long before the gorge at Gamboa is reached, the flood waters have spent their force.

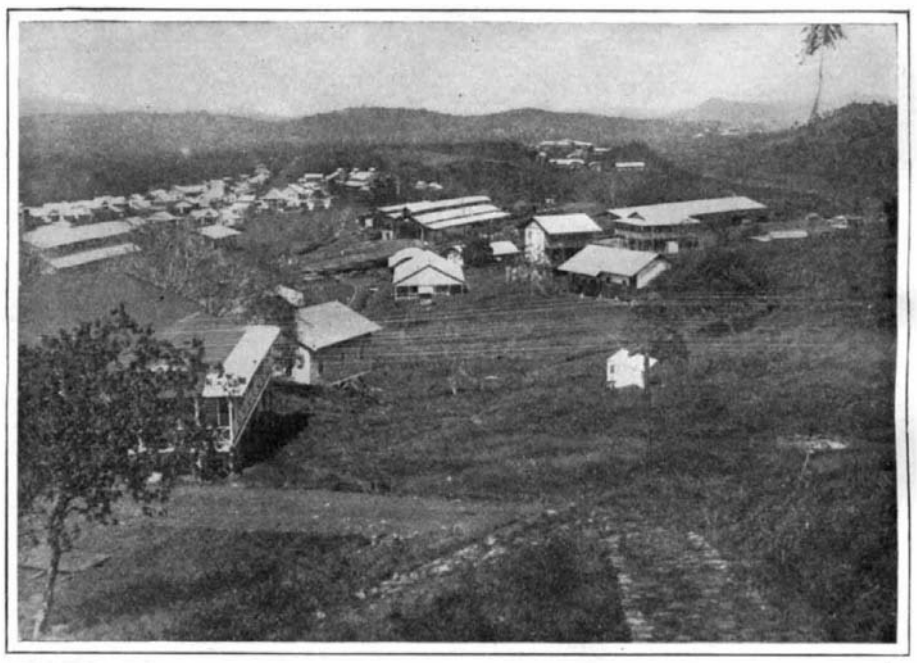
The Great Culebra Cut.—Thanks to the height of the Gatun dam, the waters of the lake were raised to such a high level that in the distance we have traveled from Gatun to Obispo the 45 feet of depth in the channel was obtained, we are told, with practically no excavation whatever in the first 17 miles of its length, and with but a very moderate amount of excavation in the next 5 miles. At Obispo, however, the canal swings rather sharply to the right, and we are confronted at once by the Culebra range of mountains through which, like a gigantic railroad cut, we see the canal excavation. For the next mile and a half the canal (we have left the lake channel and are now in the canal proper) is cut with a bottom width of 300 feet to Las Cascadas, where we enter the only stretch of the canal, 4¾ miles in length, in which the bottom width is brought down to 200 feet. The walls of the canal immediately abutting on the water are approximately vertical for a height of five feet above the canal surface. Then there is on either side a broad bench, upon the easterly one of which are the tracks of the Panama Railroad. From this bench the sides of the cut are carried up in a series of parallel steps. The distance up the sides of the cut, in the deepest portion, is between 300 and 400 feet. In passing through this section, our speed is reduced to five or six miles an hour, for the reason that if, in the restricted channel, we were to steam any faster, the ship might take a sudden veer and strike the banks before she could be brought on her course again. As we finally emerge from the Culebra hills, we see before us the gates of Pedro Miguel lock, and beyond them we catch our first glimpse of the Pacific Ocean, now only a matter of some seven miles distant. There is but one lock at Pedro Miguel, with a fall of 31 feet, but so vast are its proportions, that it cost the sum of $7,000,000 to make the huge excavation in the rock bottom and put in the concrete and cut-stone walls and the massive electrically-operated gates.

Rio Grande Lake.—We now find ourselves at the head of another great freshwater lake, formed by damming up the river Rio Grande, which heads in the Culebra Mountains and flows to the Pacific. For the first two miles from the lock to Miraflores the channel is dredged through the bottom of the lake to a width of 500 feet, and our pilot at once takes advantage of this fact by raising the speed from 5 to 12 knots an hour. At Miraflores we enter again upon unobstructed navigation, the channel broadening out to more than 1,000 feet in bottom width. Still farther increasing our speed, in a quarter of an hour we have crossed the last stretch of the lake, and are confronted by the great dam and double flight of locks at La Boca, on the Bay of Panama.

While we are being warped into the first of the double flight of locks at Sosa we learn that the Rio Grande lake required three separate dams for its formation; one about 3,500 feet long to the west of Sosa Hill, another 1,200 feet long to the east of the hill (these two serving to close the natural outlet of the Rio Grande River) while a third dam, about a mile in length, but of comparatively shallow height, being in fact more in the nature of a dyke, was built across a stretch of lowland about 1¼ miles to the northeast of the locks. The main dam adjoining the locks, which is known as La Boca dam, cost over a million and a half dollars, and the same amount was spent on the other two structures, known as the Ancon-Sosa and Ancon-Corozal dams. The Sosa locks cost $13,000,000. The descent from the Rio Grande lake to Panama Bay is made by two flights, each of 27 feet.

The Pacific Terminus.—We are now once more at sea level, and we steam at reduced speed through a dredged channel 300 feet in width until we reach deep water at the 40-foot contour line, at a distance of 4¼ miles from the Sosa locks. Here we drop our pilot, and start at full speed on our 5,000-mile trip across the Pacific. From the time when we passed between the inclosing jetties off the city of Colon to the time of entering deep water on the Pacific, a period of 11 hours has elapsed, and this in spite of the fact that we met and passed several ships on the way. The meeting of ships, however, occasioned no such delay as it does in the narrow Suez canal at sea level; for the canal superintendent dispatched the ships in such order that they met only in the broader channels or on the broad surface of the freshwater lakes. Throughout the whole of the trip, although we draw 35 feet of water, we have never had less than five feet of water below our keel; for 23 miles out of the whole distance of 49 miles, we have been able to steam at full speed in practically unrestricted navigation; for 12 miles we have steamed at three-quarter speed; and only during our passage through the 200-foot wide section of the canal at Culebra have we been obliged to come down as low as five or six miles per hour.

The Main Street of Culebra—a Typical Village on the Route of the Canal.



View of Camp at Empire on the Canal, Showing the Type of Houses Built for the Canal Employes.

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SANITATION OF THE CANAL ZONE.

SANITATION OF THE PANAMA CANAL ZONE.

Towering in importance high above all the many important problems that demand solution if the United States is to build a canal at Panama, is that of sanitation. The 25,000 laborers that will be needed, must be housed, fed, supplied with pure water, and safeguarded by a thorough system of sanitation. Furthermore, the two great scourges of the country, yellow fever and malaria, must be stamped out or kept under control, and measures taken to prevent any outbreak from becoming epidemic.

Housing.—The present commission found on the Isthmus a few large hotels for the engineering and clerical force, and 2,100 small houses for the laborers, which had been built by the French. About 1,200 of these houses have already been repaired, a large number of others built, and the hotels have been greatly enlarged. There is to-day accommodation for the 15,000 men employed on the work. The houses for the laborers are of wood, and built five feet above the ground. Each contains two or three bunks, with galvanized iron frames and removable wire or canvas bottoms; a stout table, and chairs. They are of a size that provides the 500 cubic feet of space to the man required by sanitary authorities. The camps are built on high ground, and as soon as they are established, drains are dug, sewerage put in, and the vegetation is cut down from a large contiguous area.

Water Supply.—An abundant supply of good drinking water is found in the hills that border the canal. Water is piped from reservoirs near the terminal cities of Panama and Colon, and the work of enlarging these, and putting in pipe lines to convey water to the various camps along the line from the nearest natural source of supply, is being vigorously pushed. An analysis, recently made, of the water at Culebra cut showed it to be as pure as the water from Croton reservoir. The laborers are at present being fed by the government at the rate of 30 cents a day; but it is probable that ultimately a contract will be let for the running of the mess-houses for the whole force.

Cleaning the Cities.—The system of cleaning up of the cities, which accomplished such wonders for Havana, is being vigorously carried out in the canal zone. Yards are being thoroughly cleaned, sewers put in, cesspools abolished, the garbage is regularly collected, the streets swept, and as fast as possible they are being graded and drainage of surface water established. In Colon the grade of the streets is being raised well above the marsh level, and from one end of the zone to the other, every possible precaution is being taken to render the district cleanly and wholesome.

Stamping Out Yellow Fever and Malaria at Panama.—Thanks to the splendid work of Col. W. C. Gorgas, U. S. A., the chief sanitary officer of the canal zone, it has already been proved that yellow fever and malaria, the two prevailing diseases, can be successfully combated and practically stamped out. Yellow fever is conveyed from man to man only by the female Stegomyia, who must have previously bitten some human being suffering from yellow fever. Therefore, yellow fever cannot originate in a place where there are no infected Stegomyia, until a yellow fever patient has been introduced and has infected the local pest; or until the mosquito, infected at some distant point, has been introduced. Practically, the introduction of a yellow fever patient is the only method by which the locality can be infected.

The immediate object of the sanitary measures is to get rid of all infected Stegomyia. This can be accomplished with great certainty by establishing a system whereby the health authorities are certain to be informed of every case of yellow fever; and then fumigating the house in which this case occurred, so as to destroy all the mosquitoes within its borders. The same thing must be done with all contiguous houses. It has been found by experience that this kills all the infected mosquitoes at that particular focus. By doing the same thing at every other focus as yellow fever occurs, all the foci in the community are gradually destroyed, and when the last focus has been got rid of, yellow fever is at an end. A more expeditious method is to systematically fumigate every house in the town.

The Stegomyia is a house mosquito, and being cleanly in her habits seeks principally the clean rain-water barrels and water containers, and never travels far from her birthplace. Therefore, as an additional sanitary safeguard, every receptacle for water should be so screened that mosquitoes cannot have access to it.

The safest precaution is to pipe the water supply in from a distance, so that the people will not need to keep a supply of water in vessels.

How well the government has succeeded in stamping out yellow fever, is proved by the statement of Governor Magoon, made during his recent testimony at the Senate investigation at Washington, that January 26, 1906, was the seventy-fourth day since there had been a case of yellow fever at Panama, and the ninetieth day since there had been a clearly established case at Colon.

An even more important problem than that presented by yellow fever is the control of malaria throughout the Canal Zone. The ten thousand natives of the district are distributed in about twenty small villages along the route of the canal, and these people are very generally affected with malaria. A microscopic examination of the blood of these people, taken at random at various points along the line, showed that out of several hundred cases, fifty per cent contained mosquito parasites in the blood. Four times out of five, if the female Anopheles bites a native she becomes infected, and when she bites one of our nearby laborers, he in turn becomes infected. Hence, if our laboring force is not to be completely used up, as was that of the French government, preventive sanitary measures must be taken.

There are two ways of approaching this problem; either by doing away with the infected human being, or by doing away with the mosquito. Since it is out of the question to do away with the infected natives, the remedy must be sought in the extinction of the mosquito. If some substance could be introduced into the circulation of the infected man and kill the parasite, and at the same time not be injurious to the man, the desired object would be effected, and in quinine has been discovered the suitable poison. This vegetable substance is harmless to man and fatal to the malarial parasite. Most of the effective tropical sanitarians, the Germans and the Italians conspicuously, have achieved a great success by inducing as large a proportion of the population as possible to take regularly small quantities of quinine, and they have succeeded, without adopting any other measures, in doing away with malaria in the several localities.

The disease may also be successfully attacked from the side of the mosquito, and the Anopheles may be as effectively exterminated as the Stegomyia by covering up water containers, clearing up the yards, preserving the surface of the road so there will be no puddles, instituting a regular system in all towns for the collection of garbage, and by the use of oil. Asked in regard to the prevalence of malaria, Governor Magoon stated that the percentage of malaria on the Canal Zone today is no greater than it was in any of our frontier States while they were new countries in process of being settled. Col. Gorgas confidently expects to get malaria as completely under control as yellow fever is now known to be.

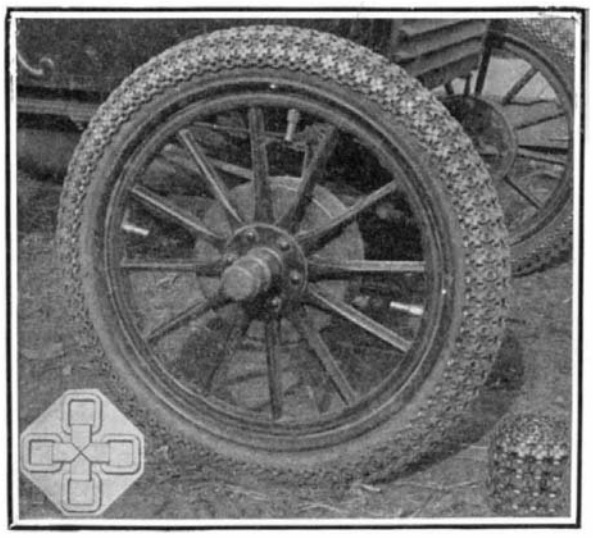
Price of Carrier Pigeons.

The cost of valuable pigeons, even at auction sales, is higher than generally supposed. Within a few weeks, 92 pigeons of the Coucke variety produced a total of 3,772 francs, or 41 francs per head on the average. More recently, according to M. Thauzies, 196 pigeons belonging to M. Hausenne, of Veviers, sold for 14,000 francs, or 71 francs each on the average. Certain subjects, where the competition was lively, brought 240, 300, 400, and even 550 francs. A single amateur paid the sum of 1,485 francs for three pigeons. After having read these facts, hunters who so far forget themselves as to fire at carrier pigeons will be doubly criminal.—La Nature.

Treatment of Pyrites Containing Gold.—Several geologists, notably Signor Mors, have expressed the opinion that wherever traces of free gold exist, there is in the neighborhood a still richer source in the form of combined gold. This theory has been confirmed by the process of a Belgian chemist, M. Body, who, experimenting in Italy, has actually effected the geological synthesis of the formation of alluvions and, according to Italian journals, has confirmed the theory attributing the formation of placers to volcanic action. The process is based, not on the elimination of the sulphur, but on its addition. The yields of gold resulting exceed those obtained by means of leading and cupellation. Founded on the polysulphuration obtained by a chemical disaggregation of the ore in presence of special salts under the influence of a temperature not exceeding that of the cherry red for a comparatively short duration, the action of this disaggregation disengages gold from its most stable combinations. In the Piedmont factory, where the process was carried out, the expense, it is said, did not exceed 10 or 15 francs per ton of ore treated. In fine, obstinate pyrites was converted into a product which could be treated by ordinary methods. As gold-bearing pyrites occur in large quantities in nature, it is evident that the new method has a wide field for development.

A NEW DETACHABLE NON-SKID TIRE PROTECTOR.

A patent has just been granted to Mr. Lewis Slama, of Humboldt, Neb., on a new tire guard for automobiles, to prevent skidding on wet pavements or slipping on snow or ice. The construction of the guard is clearly illustrated in the accompanying engraving, which



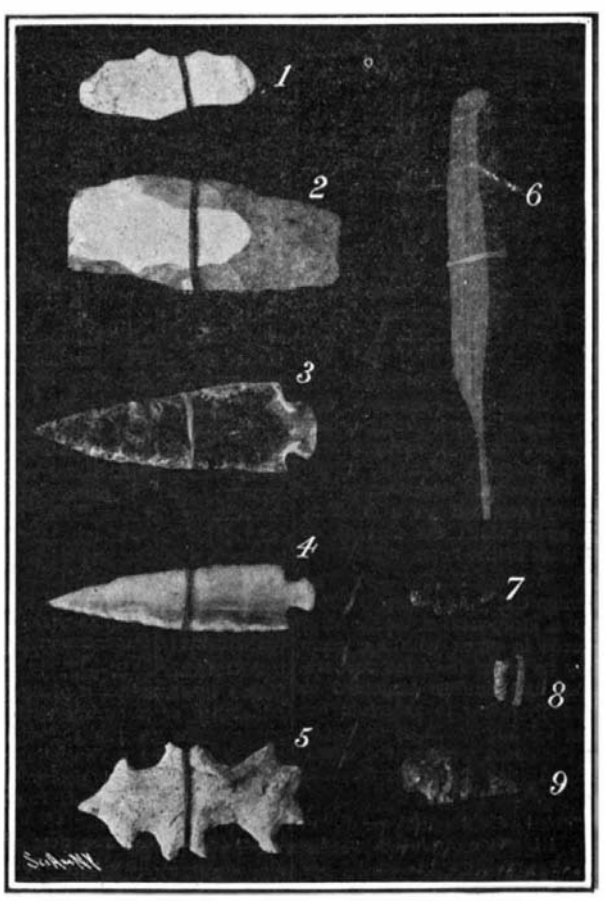
IMPROVED TIRE PROTECTOR.

shows the device in position on an automobile wheel. The guard, it will be observed, is made up of cruciform links and ring-like links alternately connected together to form a broad chain or heavy netting, which is mounted on the tire. The cruciform links are very simply made out of sheet metal cut to the shape of a cross, the four arms being passed through ring links and bent in toward the center, as shown in the detail view. The links along the edges of the guard are made a little smaller, so that the guard will shape itself to the form of the tire. For this reason, when the guard is applied to the wheel and the ends are joined, it will keep its position, even when quite slack. The only parts of the guard that bear against the tire are the flat cruciform links, the edges of which are turned up, so that there is no danger of wear. We are informed that the guards shown in the photograph were in constant use on the same tires for several months, and that although the tires were old when the guards were applied, no tire troubles were experienced in the hundreds of miles run. Aside from its non-skidding advantages, the guard serves to prevent destructive side wear, due to running in ruts, and also affords a protection against puncture. When not in use the band may be conveniently rolled up, as shown in the foreground of the illustration.

ARROWHEADS SHAPED WITH A WOODEN IMPLEMENT.

BY F. C. MASON.

Pictured in the accompanying engraving is a remarkable set of glass and flint arrowheads, which were chipped out of the rough material with an ordinary stick of oak as a tool. The wooden tool is shown in the photograph, and its worn end indicates the use to which it has been put. The work is that of Ernest Baurman, a young lad living near Berlin, Mich., who without instruction learned the trick after three years of experiment. The boy became interested in the arrowheads which were turned up on his father's farm, and became curious to learn how the Indians could have made them without metal tools. His curiosity led to a careful study, not only of the arrowheads themselves, but also of the chips which had been split off in making the arrowheads. This, he says, taught him in what direction the pieces were flaked off, and gave him the clew which led him to the solution of the mystery. Before deciding on a wooden stick as a proper implement for fashioning arrowheads, he first tried many different materials, but eventually came to the conclusion that a stick of oak was the most suitable. The arrowheads shown in the illustration were made in the presence of Mr. Kendal, a friend of the writer's. Fig. 1 is a chip removed from the piece of flint illustrated in Fig. 2, and shows how large a bit can be removed when necessary. Young Baurman, who had previously operated on glass, was given a piece of French mirror plate, and out of this he formed the beautiful arrowhead shown in Fig. 3. The work was executed in about an hour, and is superior in style and finish to any prehistoric specimen of flint ever seen. Fig. 4 is an arrowhead chipped out of opalescent glass, and Fig. 5 is a specimen of work on a piece of white flint, which shows how intricate a design the boy can follow. A flint arrowhead is shown in Fig. 9. Among Mr. Kendal's specimens was a small piece of volcanic glass or obsidian. The piece was ½ x ⅛ x 1½ inches long. He handed it to the boy, requesting him to make an arrowhead out of it. The boy replied that with his permission he would break off a piece to see the texture of the material. Permission was granted, and about half an inch was broken off. Then out of the larger piece the boy fashioned the arrowhead represented in Fig. 7. The remainder is shown in Fig. 8. This arrowhead is almost perfect in its symmetry, the point being as sharp as a needle and the edge keen, but not jagged. The thickness, at the thickest part, measures about 3/32 of an inch, and the tang for fastening to the arrow is not over 3/64 of an inch thick.



GLASS AND STONE ARROWHEADS FORMED WITH A STICK OF WOOD.

But most remarkable is the instrument used in making the arrowheads. This is shown in Fig. 6. It is a simple piece of oak about 5 inches long and slightly pointed. The exact movement of operation Mr. Kendal has not mastered, but it seems to be a twisting action which flakes off the chips. I made some experiments for myself on a piece of flint, and succeeded in removing flakes with a small piece of hard maple. The largest chip measured about ¼ x ¼ inch. The boy removed flakes as large as ½ x 1¾ inches. The secret lies in a knowledge of the composition of the texture of the stone. You must start the flake at the right place each time. For many years scientists were puzzled by the same problem that presented itself to young Baurman, namely, how arrowheads of flint could be fashioned without metal implements. The solution of the problem was found in Tierra del Fuego, where the natives fashioned implements of flint and glass with tools of walrus bone in much the same way as the Michigan lad performs his work. To the latter, however, belongs the credit of being the first white man to master this art.

New Microphone Transmitter.

A new form of microphone transmitter has lately been invented by the Italian engineer Quintana Majorana, of the government telegraph department. It differs entirely from the ordinary carbon microphone which is in common use, and is based upon the capillary contractions which the sound vibrations are made to produce upon a liquid jet. The principle upon which this action is based was observed by Chichester Belt some twenty years ago. The contractions of the liquid vein rise to corresponding variations in the electrical resistance of the circuit. Using an induction coil we are able to obtain telephonic currents which under favorable conditions may reach, for sounds whose vibration is 500 periods per second, an intensity of 100 milliamperes. This is a much more powerful effect than can be produced in the telephone at present. Besides the loud-speaking telephones, we may remark the Bailleux microphones which are used on the government lines in Italy and give only a current of 20 or 25 milliamperes, which is among the highest figures. In the new instrument it is claimed that the sound is clear and sharp. The construction is not as simple as a carbon microphone, but there is a great gain in power which will give it the advantage.

Concentrated Lye.—By combining different salts contained in wood ashes in the following proportions, though they are not absolute, a good lye is produced: 16 per cent of sulphate of potash, 2 per cent of potassium chloride, 76 per cent of carbonate of potash, and 6 per cent of carbonate of soda. The compound can be made up in small tablets, weighing about 0.0130 of a gramme, for bleacheries and for household use. Each tablet is sufficient for 40 liters of water; it will clean the linen, giving a perfect white and leaving a good odor.—Revue des Produits Chimiques.