The Railroad across South America.

El Echo de los Andes, a semi-technical newspaper, in its issue of August 28, gives the latest particulars concerning the Transandine Railroad. Attention is especially called now to the cutting of the tunnels which, under the snowclad mountain, will unite Chili and the Argentine Republic. The total length of the tunnels already cut is 1,800 meters (the meter being equal to 39·38 English inches); 750 meters on the Chilian side and 1,050 on the Argentine side.

The international railroad of the Andes, as is well known, is being built jointly by Chili and the Argentine Republic, the two countries which it will unite directly, and each of which is working on its own territory The frontier limit of the two nations is in the tunnel of la Cumbre, or "the Summit." The Buenos Ayres government began its tunnel work three months before Chili, which explains the fact that out of the 1,800 meters of pierced tunnel only 750 belong to Chili. But this difference will not be maintained, for Chili is now working more rapidly. For instance, 180 meters have been recently perforated on the Chilian side, while only 160 were cut on the Argentine side within about the same length of time.

The monthly progress in perforating amounts to about 450 meters. There is a succession of eight tunnels, crossing from one side of the Andes to the other. The tunnels, with their lengths, are as follows:

Tunnel.	Length in meters.
Juncal	1,104
Juncalillo	1,275
Portillo	1,885
La Calavera	3,750
La Cumbre	3,065
Las Cuevas	850
Navarro	756
Las Lenas	690
Total length	15,375

Of these tunnels, 11,158 meters are on the Chilian territory and 4,217 on Argentine. The work is, therefore, of greater importance to Chili than to the Argentine, not only on account of the large number of miles to be tunneled, but also because the engineering difficulties are greater. For instance, the tunnel of Del Portillo is really a curiosity. It is helicoidal in form, and is like an immense corkscrew, winding under the mountain. Its upper opening is 135 meters above its lower entrance. The tunnels are divided into three sections, two belonging to Chili and one to the Argentine Republic. The section of Juncal includes the two tunnels of Juncal and Juncalillo; and that of Calavera includes the tunnels of Portillo, Calavera, and Cumbre. All these are on the Chilian side, while the section of Las Cuevas is on the Argentine side.

In each of those sections are erected houses for engineers and workmen, hospitals, office buildings, etc. They are built of materials capable of resisting the intense cold of those high regions.

The tunnels are attacked in twenty-six different places; half on the Argentine and half on the Chilian side. The finest machinery and engines are used, and motive power is mainly furnished by electrical machines, working on a larger scale than has ever been attempted before in similar undertakings. It is calculated that, through the use of that kind of motive power, and of improved machinery, the work moves four or five times as rapidly as if it were done by the ordinary methods.

African Earthworms.

The last *Kew Bulletin* contains a report by Mr. Alvan Millson, the Assistant Colonial Secretary of Lagos, on Yoruba Land, the native territory adjacent to Lagos. After describing the wasteful system of cultivation employed by the natives and the wonderful rapidity with which the soil recovers from it, he says the mystery is solved in a simple and unexpected manner during the dry season. The whole surface of the ground beneath the grass is seen to be covered by rows of cylindrical worm casts. These vary in height from a quarter of an inch to three inches, and exist in astonishing numbers. It is in many places impossible to press a finger upon the ground without touching one. For scores of square miles they cover the surface of the soil, closely packed, upright, and burnt by the sun into rigid rolls of hardened clay. The rains ultimately break them down into a fine powder, rich in plant food and lending itself easily to the hoe of the farmer. These casts are very different in form from those familiar in English gardens. On digging down, the soil is found to be drilled in all directions by a countless multitude of worm drills, while from 13 inches to 2 feet in depth the worms are found in great numbers in the moist subsoil. It is impossible to estimate their number per cubic foot, as the quantity varies according to the season and the locality. Having carefully removed the worm casts of one season from two separate square feet of land at a considerable distance from one another, and chosen at random, Mr. Millson found the weight to be 10¾ pounds in a thoroughly dry state. This gives a mean of over 5 pounds per square foot, and a total of not less than 62,233 tons of subsoil brought to the surface on each square mile of cultivable land in the Yoruba country every year. This work goes on unceasingly year after year, and to the untiring labors of its earthworms this part of West Africa owes the livelihood of its people. Where the worms do not work, the Yoruba knows that it is useless to make his farm.

Estimating 1 square yard of dry earth by 2 feet deep as weighing half a ton, there is an annual movement of earth per square yard of the depth of 2 feet amounting to not less than 45 pounds. From this it appears that every particle of earth in each ton of soil to the depth of 2 feet is brought to the surface once in twenty-seven years. If seems more than probable that the comparative freedom of this part of West Africa from dangerous malarial fevers is due, in part at least, to the work of earthworms in ventilating and constantly bringing to the surface the soil in which the malarial germs live and breed. From specimens which Mr. Millson has sent home it appears the worm belongs to a new species of the genus *Siphonogaster*. The type of this genus has been quite lately described from the Nile mud.

BACILLUS OF TUBERCULOSIS.

It is well known that infectious diseases, such as consumption and cholera, have a parasitic origin, and that each one of them has its characteristic micro-organism. In 1878 Dr. Koch published his "Untersuchung ueber die Aetiologie der Wundinfectionskrankheiten," which embodied the results of his investigations in this field of research and formed the basis of future study, the result of which was the discovery of the bacillus of tuberculosis. The course followed by Dr. Koch has been so fully explained in former issues of the SCIENTIFIC AMERICAN that it seems unnecessary to treat the subject again in detail, but we publish to-day two excellent cuts, for which we are indebted to the *Illustrirte Zeitung*, showing the bacilli alone and as they are found in the tubercles.

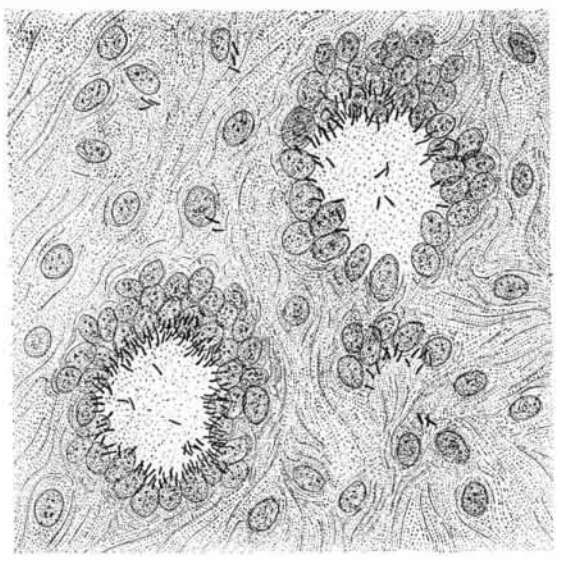

Fig. 1.—SECTION THROUGH TUBERCLES OF THE LUNGS, SHOWING TWO LARGE CELLS WITH NUMEROUS BACILLI.

The specimen having been colored, the bacilli appear as dark dashes. Magnified 800 times.

Dr Koch's methods, which have been so strikingly confirmed by his work, have opened new fields in the science of bacteriology, and the results of his work have been felt in every department of medicine.

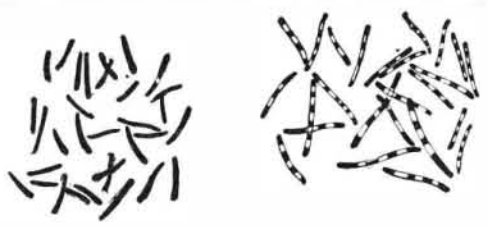

Fig. 2.—TUBERCULAR BACILLI, MAGNIFIED 2,000 TIMES.

At the left, bacilli free from spores. At the right, bacilli with colorless places which are supposed to be spores.

Photo Carbon Printing.

BY T. C. ROCHE.

The principle or foundation of carbon printing is based on the action of light on bichromate salts when combined with organic matter. This discovery was first brought to public notice by Mungo Pontou in 1839. M. Becquerel, Mr. Fox Talbot, and others experimented on this new reaction, but M. Poitevin, in 1855, was about the first to bring out any real practical results. It was through him that photo-lithography, photo-mechanical printing and kindred processes were put into commercial use.

The first to introduce prepared carbon tissue, and a practical formula for working the same, was Mr. J. W. Swan, in 1864. Since then there have been several important improvements made, simplifying the process still more. A suitable paper is coated in long rolls with a pigmented gelatine; this is cut to the required size and sensitized for use in a bath of bichromate of potash, 15 to 20 grains per ounce of water. When dried in a dark room it is ready for exposure, under the negative, to the action of sunlight. It is important that the negative has a safety edge about half an inch all around it, to prevent the light from acting on the margin of the tissue. After exposure, which must be judged by a photometer, the tissue is placed in cold water until it lies limp and flat. Your glass or porcelain, which has been cleaned and coated with plain collodion, is wetted or washed in water, then laid on a table, some water sprinkled on, the carbon paper is laid face down on it, a thin rubber cloth laid over, and then a squeegee passed over lightly to bring the carbon paper in contact and drive out all air bells. It is now allowed to rest for a few minutes, then placed in a pan of tepid water and rocked. The first portion of the gelatine mixture to dissolve is that which had been protected by the safety edge on the negative. Now the paper which had been coated can be peeled off and the transferred picture washed out according to the gradation or tones in the negative and the action of light on the sensitive compound. The coating is rendered more or less insoluble, and all soluble portions will wash out in the warm water. The picture is then washed in cold water, and finally a solution of alum water is flowed over and the plate set up to dry. While the surface is wet it is very tender, but will dry hard and sharp.

The collodion is used to prevent the delicate detail or half tone from washing away. In sensitizing or washing, the light has no effect on the material while wet. After sensitizing, the paper will keep two weeks if put in an air-tight tin box. Porcelain or zinc plates that have been cleaned, slightly waxed, and then collodionized, can have the proofs developed on them re-transferred when dry on to transfer paper by wetting the paper until it feels slimy, then squeegeeing it down on the picture, and when dry it can be peeled off easily. Proofs on porcelain or for lantern slides should be printed light; those for window transparencies, deeper. The proofs can be, after printing, transferred to almost any material, such as celluloid, metals, or wood. When you hang the paper up to dry after sensitizing, it must be in a room well ventilated; if not, the coating is apt to dry insoluble and will be of no use. All carbon pictures are considered permanent.—*Jour. Soc. Am. Photo.*

Completion of the Great Mountain Bridge.

The new Verrugas bridge was lately opened for traffic. The bridge is of the cantilever type, supported on two iron towers. Its total length is 575 feet, its suspended span being 105 feet long. At its middle point it is 252 feet above the bottom of the valley which it spans. The bridge is entirely of wrought iron, and was constructed by Cooper, Hewitt & Co. at their works in Trenton.

The Verrugas bridge is one of the features of the Oroya Railway, now known as the Central Railway of Peru. This railroad starts from Callao on the Pacific, runs through Lima, and thence ascends the Andes by difficult grades, reaching its greatest elevation at Chiela, about 12,300 feet above the level of the sea. The bridge spans a chasm of 235 feet in width, with precipitous sides, and replaces the old Verrugas viaduct built in 1871, which was destroyed in March, 1889, by floods.

The Harvester Trust.

A mammoth combination has been effected between the harvester machine companies of the United States. The new trust is to bear the name of the American Harvester Co., and it has been organized under the laws of the State of Illinois, with a capitalization of $35,000,000. The following companies have acknowledged their allegiance to the new company: The McCormick Harvesting Machine Company, Chicago; the Walter A. Wood Mower and Reaper Machine Company, Hoosick Falls, N. Y.; Warder, Bushnell & Glessner, Springfield, O.; Aultman, Miller & Co, Akron, O.; the Whitman & Barnes Manufacturing Company, Akron, O.; the Plano Manufacturing Company, Plano, Ill.; the Milwaukee Harvester Company, Milwaukee, Wis.; the Esterly Harvesting Machine Company, Whitewater, Wis.; the Minneapolis Harvester Works, Minneapolis, Minn.; Emerson, Talcott & Co., Rockford, Ill.; the J. F. Seiberling Company, Akron, O.; Seiberling, Miller & Co., Doylestown, O.; Amos Whitley & Co., Springfield, O.; Hoover & Gamble, Miamisburg, O.; D. M. Osborne, Auburn, N. Y.; the Richardson Manufacturing Company, Worcester, Mass.; Adriance, Platt & Co., Poughkeepsie, N. Y.; D. S. Morgan & Co., Brockport, N. Y.; the Johnston Harvester Company, Batavia, N. Y.

The incorporators are Cyrus H. McCormick, Wm. Deering, Hon. Walter A. Wood, Hon. Lewis Miller, Gen. A. N. Bushnell, and Col. A. L. Conger.

Some idea of the interests that will be affected by the trust may be inferred from the fact that nearly all the farmers will be affected favorably or unfavorably by the trust, and it is stated that the companies included in the corporation employ some 15,000 men.