editor. This periodical devotes special attention to the study of the Basque dialects, traditions, and literature.

The tribes of northern and north-western Australia, of which so little is known, have been sketched by Edward Palmer in the *Journal of the anthropological institute*, 1884, pp. 276-334. His article contains statements which evidently come from an experienced traveller. Nine tribes are described as to their physical and social characteristics, cannibalism, food, cooking and hunting, weapons, manufactures, amusements, superstitions, bora-ceremonies, funerals, etc. The chapter on *gentes*, or, as Palmer calls them, class-systems, brings together a large amount of new facts; and the seven vocabularies concluding the paper extend over more than a hundred and sixty terms. A. S. GATSCHET.

MODERN RAIL-MAKING.

THE making of steel rails consists of three distinct processes: the production of cast-iron from the ore; converting the cast-iron into steel in a Bessemer converter, and casting it into ingots; and rolling out the ingots into rails. According to the most recent practice, these operations follow each other so closely as to seem almost one.

Cast-iron is obtained from iron ore by reducing the ore in a blast-furnace with coke for fuel, and limestone as a flux to facilitate the reduction. The blast-furnace consists of an approximately cylindrical iron structure about seventy-five feet high, lined with bricks of refractory material, leaving an internal diameter of about twenty feet. A similarly lined bottom is securely fastened on, but can be removed for repairs. The top is closed by a cone-shaped cover suspended inside of the top of the furnace, which is here reduced in diameter. This cone is held in place by a lever and counter-weight. Air is supplied under pressure by blowing-engines, which are simply large air-compressing pumps, through openings, or tuyères, near the bottom of the furnace. The hot gases of combustion escape through openings near the top of the furnace, and are conducted away by pipes and underground conduits, — part to heat the boilers, which supply steam to the blowing-engines; and part to 'stoves,' to heat the air-blast on its way from the engines to the furnace. These stoves consist of a number of up-and-down passages built in fire-brick. Gas from the furnace is burned in one of them until it is highly heated; then the gas is turned into a cool stove, and the air-blast forced through the hot one.

The iron ore, as received from the mines, is stored in a large yard, each kind of ore occupying a specified place. The coke is stored in a large and high shed, into which it is unloaded from cars run in on overhead railroad-tracks. Supposing the blast-furnace to be in operation, the ore, limestone, and coke are loaded in hand-carts, as required; hoisted on an elevator to the charging-floor, which is on a level with the top of the furnace; and dumped upon the cone cover before mentioned. When the requisite number of loads of each kind of material is deposited on it, the cone is lowered for an instant, and the charge slides over its edge into the furnace. The ore is reduced, forming iron, which sinks by its weight to the bottom of the furnace, and a glassy slag containing most of the impurities, which floats on the top of the iron. The molten iron is drawn off through an opening at the bottom of the furnace, and, flowing through a channel in the sand floor, runs into a cup-shaped ladle holding between five and ten tons. This ladle is mounted on a narrow-gauge car on a track which leads to the converter. This completes the first stage of the process. If the iron drawn from the blast-furnace were run into channels on a sand floor, and allowed to cool, it would be the ordinary form of cast-iron known as pig-iron.

The converter, which is the essential feature of the Bessemer process of making steel, consists of a cylindrical iron casing, on which is placed a tapering portion, connecting it to a nozzle of smaller diameter. This nozzle is inclined at an angle of about forty-five degrees to the cylindrical part. The whole casing encloses a thick lining of highly refractory material. The bottom is double, the upper part being made of material like the lining, and pierced with numerous small holes, through which the air is forced in. The converter is supported on two hollow trunnions, through which the blast is supplied, and led by pipes to the double bottom. We will suppose that the converter has been heated, and is ready for a charge. The ladle of molten iron from the blast-furnace is drawn by a locomotive on an elevated track to a point a few feet above and in line with the converter. The latter is turned on its trunnions until the iron is readily poured into it from the ladle, through the nozzle or mouth. The blast of air is turned on at a pressure increasing to twenty-five pounds per square inch, and the converter turned upright. Rapid combustion takes place, the principal impurities in the iron are first attacked and burned out, the free or uncombined carbon burns next, then the combined carbon begins to leave the iron, and shortly a nearly pure iron is left in the converter. It is now turned as before, and the blast stopped: if continued, the iron itself would be oxidized. This portion of the process usually occupies about ten minutes, although some ores do not require over six, and twenty may be necessary with others.

In the mean time, an iron rich in carbon and manganese, called spiegeleisen, has been melted in a cupola resembling the blast-furnace. A definite quantity, determined by experience and analysis, has been run into a car-ladle; and, as the converter is turned at the end of the 'blow,' this car is drawn out on the track before mentioned, and the spiegeleisen poured into the converter. This is to replace, to a certain extent, the carbon burned out during the blow; the quantity being exactly determined by the quality of steel required, according to the general principle that the more carbon added, the harder is the product. The converter is now turned down; and the molten steel, which may be as much as ten tons, is poured from the nozzle into a ladle. This ladle is mounted on a hydraulic crane which stands in the centre of a pit about five feet deep, called the ingot-pit. Around the circumference of this pit are arranged the cast-iron ingot-moulds, and the steel is drawn off from the ladle into them. A sample from each charge is tested by bending, punching, etc., and by analysis; so that an exact record is kept of each ten tons of steel. After a short interval, the ingot-moulds are lifted off: the ingots, which are approximately four feet long and twelve inches square, are taken from the pit, and loaded on cars, to be taken to the rail-mill. Thus far the methods are almost identical for all kinds of Bessemer-steel work.

The ingots arrive in the rail-mill at a dull red-heat on the outside, while the interior is at a much higher temperature. They are therefore placed in gas reheating-furnaces until at a uniform temperature, at which they can be easily worked. Following the course of one ingot, it is taken on a truck from the reheating-furnace to the rolls between which it is to be passed, and to emerge a long, perfectly shaped rail. The rolls are of cast-iron, and are in two sets, — the roughing-rolls and finishing-rolls. The first set consists of three rolls placed in a vertical row, and turning in a strong frame at each end. The ingot, or bloom as it is now called, is passed between the lower and middle rolls near one end, and is reduced in section, and lengthened. The platform on which it now rests is raised, and the bar is sent back between the middle and top rolls. The platform is lowered again; and, as it descends, a row of iron fingers, projecting up from beneath it, turns the bar, and moves it toward the middle of the rolls. Thus it is sent, through and up, back and down, moved from one end of the rolls to the other, being thereby reduced in section and correspondingly lengthened, until it finally leaves the roughing-rolls, having the approximate shape of a very large rail. As this bar goes through the roughing-rolls for the last time, another bloom is put on, and goes through for the first time at the other end of the rolls. Without a pause, the bar is carried along on revolving-rollers in a direct line to the finishing-rolls. These are two-high and reversing; being rotated first in one direction, and then in the other. The shape of the spaces between them is such that the last passage of the bar gives it the form and size of section required in the finished rail. After being sent through these rolls the necessary number of times, the finished rail-bar passes on in a direct line, as before, until it reaches a circular saw, which is swung up against it, and the rough or scrap end sawed off. The saw is swung to one side, and the bar moved along until the cut end comes against a stop-plate, which is at a distance equal to the length of one rail from the saw; and a slight motion of the saw cuts off the length. The stop-plate is swung to one side, and the rail is carried along to a large platform formed of rails laid at right angles to its direction. The rail is seized between a curved bar and a row of iron fingers which rise from beneath the platform or 'hot-bed,' and is bent. This is necessary in order that the rail shall be approximately straight when cold, as on account of the irregular shape of its section, if straight when hot, it would bend in cooling. After being bent, the rail is slid by the curved bar to either end of the hot-bed, where it is left to cool. When cool, any curves in its length are removed under a press; the rough edges left by the saw are removed with hammer, chisel, and file; the holes for the joints are drilled at both ends simultaneously; and it is loaded on a car close at hand, ready for shipment.

Each ingot makes four rails with two scrap-ends. The rail-bar, as it leaves the finishing-rolls, is thus about one hundred and twenty-two feet long. The weight of rail is regulated by adjusting the distance between the finishing-rolls, and gauging the length of the ingot in the mould. A different form of cross-section, of course, necessitates a change of finishing-rolls. From the time the ore is melted in the blast-furnace, until the rail is left on the hot-bed to cool, the temperature of the metal does not fall below that of a red-heat. ARTHUR T. WOODS.

THE GEOLOGICAL RELATIVES OF KRAKATOA AND ITS LATE ERUPTION.

Topographische en geologische beschrijving van een gedeelte van Sumatra's westkust. Door R. D. M. VERBEEK. Batavia, *Landsdrukkerij* (Amsterdam, *Stemler*), 1883. 20+674 p. 8°. Atlas of maps, and portfolio of plates. [Our figures, 1, 2, are from this work, with slight alteration.]

Kort verslag over de uitbarsting van Krakatau op 26, 27, en 28 Augustus. Door R. D. M. VERBEEK. Batavia, *Landsdrukkerij*, 1884.

IT happens well, that, just after the attention of the scientific world is called to the Dutch East Indies by the eruption of last August, there should be published an important work on the geology of a part of Sumatra, in which the relations and structure of the great Javanese and Sumatran chain of volcanoes are described with much thoroughness. We must congratulate Mr. Verbeek on the opportune appearance of his volume and atlas on 'Sumatra's westkust,' as well as on his prompt action in gathering material for a history of the outburst of Krakatoa, of both of which we can give but too brief a mention in this notice.

Introductory to these reports, one should read over K. Martin's review of the present knowledge of East-Indian geology,[1] which contains in an appendix a list of forty-seven publications on the subject; or the brief statements of the question by Verbeek himself that have been prepared for recent exhibitions;[2] and, in

1 Die wichtigsten daten unserer geol. kenntniss vom niederländisch Ost-indischen Archipel. Bijdragen tot de taal-, land-, en volkenkunde van Neerlandsch-Indië, 1883.

2 Descriptive catalogue of rocks, coal, and ores from the Dutch East-Indian Archipelago, prepared for the Melbourne international exhibition, 1880. (Batavia, Kolff.) Géologie des Indes néerlandaises, prepared for the international exhibition at Amsterdam, 1883.