

same amount of heat developed, the only difference being that in the atmospheric burner the carbon and hydrogen are both oxidised simultaneously, whereas in the illuminating jet the hydrogen burns first, intensely heating the particles of carbon, which thus become luminous, and are then perfectly oxidised as they come in contact with the air at the surface of the flame. The result of this is that the total heat developed is the same in both cases, for the same amount of gas consumed; but whereas the hot gases produced by the air burner will only radiate about one-tenth of their heat, the rest being in the form of highly heated gaseous matter, in the other about one-half the heat is developed in each form. If, therefore, the radiated heat is allowed freely to dissipate itself a larger portion is lost when illuminating jets are used, but if, as in this apparatus, the jets are surrounded by a chimney, so that the radiated heat cannot escape, the results would be the same in both cases in producing the comparatively moderate temperature required for cooking.

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THE SOUDAN RAILWAY EXPEDITION.

(Continued from page 135.)

After quitting the Nile at Ambukol, about latitude 18 degrees, and the northern limit of the tropical rains, the Bahiuda desert is reached. This tract of country is very unlike the sterile and rocky districts further north and shows abundant signs of vegetation along the course of the proposed railway. Wadys, pastures of long, coarse grass, and many clusters of trees are seen, whilst during the rainy season the ground is susceptible of profitable cultivation in some parts. Above Halfa, as we have previously remarked, was the point selected as the junction of the third and fourth divisions of the staff, the former working back to Ambukol, and the latter from Shendy the southern terminus, to Abou Halfa. The junction of the railway centre line at this place is across a large river bed, which in rainy seasons receives the drainage of a large watershed from a range of granite, sandstone, and porphyry hills lying towards the east. About three miles east of Abou Halfa are the wells of that name, consisting of holes made in the bed of the river, and varying from 5 ft. to 10 ft. in depth, and 3 ft. or 4 ft. in diameter. The sketch on page 166 taken near the wells on the north side of the river, showing the manner in which the banks are scoured away, gives an idea of the velocity with which the water rushes down during the brief, but severe, rainy season. To a breadth of half a mile on each side of the river the mimosa trees abound, and the Sabas grass is also beautiful; this, with the tress grass, forms the principal food of the flocks and herds—goats, camels and cattle—belonging to the Desert Arabs. For about 6 miles after leaving Abou Halfa the line falls, with easy gradients, in a south-easterly direction, passing for about half the distance over a sandy desert with sandstone rocks cropping up all round. Then the line rises with grades as easy, and enters a country wooded thickly with the mimosa, and covered with coarse grass. On the western side stand isolated rocks of sandstone, and on the east is seen the extension of the range from Abou Halfa, which vanishes with an abrupt turn eastward. About 3 miles on the east side of the line are the wells of Gakdool, which receive a part of the same watershed that supplies Abou Halfa, whilst in a south-easterly direction, and about 8½ miles from the line, the same range supplies the water for the El Faar wells, where large Wadys and river beds exist, indicating the periodical flow of great bodies of water through these lines of natural drainage, but which is gradually evaporated or absorbed in the arid desert plains.

On the western side of the line, in the valley of Gakdool, a range of sandstone rocks die out, disappearing with isolated fragments about 100 ft. in height, round which the line passes in tending more towards the south. Just at the point when this change of direction takes place, one of the most picturesque portions of the country upon this section of the line is found. It is situated at the foot of these rock ranges; the valley, as it gradually narrows up towards the wells of Gakdool being seen, and the range towards the south leading in the direction of the wells of El Faar, the valley being also broken up with isolated rocks whilst around, every species of

mimosa is found, and indigenous shrubs, grasses, and plants cover the ground. We shall publish a sketch of this spot in our next number.

Quitting this fertile place the line continues to ascend passing through sandstone rock, quartz boulders and granite with masses of conglomerate, but entirely devoid of vegetation. For about seven miles further the line follows the same southerly direction, rising with easy gradients and passing through sandstone rocks, black ballast and conglomerate boulders, but for the most part the ground is covered with a sandy deposit producing Sabas grass and mimosa. During the next eight miles the railway runs through a somewhat similar ground, partly covered with volcanic debris, and at first over soil just able to produce vegetation, but which afterwards gives way to hard gravelly sand, sun-baked, and cracked in all directions by the weight of passing camels. At the end of this eight miles—the 49th mile from Wady Halfa—the remarkable conical rock of sandstone, called Jebel-el-Noos, is first seen. This hill serves as a prominent and striking landmark, but the railway does not reach it until the 500th mile. Before this the line rises, and enters a tract where much drift-sand prevails, which, often obliterating all traces of the beaten camel tracks, renders Jebel-el-Noos an invaluable landmark. On the western side, sandstone rocks crop up from the surface, forming continuous ridges 100 ft. high, and smaller isolated hills, close to which the line passes, and continues to rise gently until Jebel-el-Noos is left behind about half a mile to the east, and a valley is approached in which drift-sand becomes heavier, but where trees and grass grow abundantly; on either side, however, the aspect of the ground is most forbidding, the rock surrounding the valley, seen from an elevation having the appearance of a troubled, stormy sea. The drift-sand continues in the valley only for a distance of about three miles. Some distance from Jebel-el-Noos, another remarkable desert beacon is seen, and is known to the desert Arabs as Jebel-el-Sergam, or Saddle hill. After deviating somewhat to the east and west through the valley, the line again follows the ruling course of a few degrees east of south, sandstone cropping up all around while a number of black conical hills are seen with coarse grass growing in the lower levels. The summit level of the line is passed during the next 5½ miles, the exact point where it occurs being 507 miles from Wady Halfa, and the height only 79-30 ft. above rail level at that place. The steepest gradients in this division occur at this spot, where, for short distances, 1 in 70 and 1 in 100 are employed. After crossing a grass-grown Wady that partially drains a range of hills on the west, Jebel-el-Sergam, the landmark already mentioned, is passed, the line leaving it about a quarter of a mile to the eastward. The ranges of hills east and west gradually disappear here, affording an opportunity for the adoption of easy falling gradients, which are continued as far as 8½ miles from the summit level.

The valley around Jebel-el-Sergam is fertile, containing much grass and groups of trees; as it affords good pasture for camels, it is always selected as a resting place when the traveller cannot reach the nearest wells. A few miles beyond the summit level another Wady is met, which the line crosses; this Wady drains the southern side of the range of hills just spoken of, and is about a mile in width, being well covered with trees and grass; the drainage runs, as in the one before mentioned, from west to east, but the water is quickly evaporated and absorbed by the sand. For the next 12 or 13 miles the line runs through the district of Omit Handll. On first entering this district the railway turns slightly to the west, and passes round the foot of the southern range of hills, which after extending for several miles here die out, leaving beyond them much broken sandstone and loose rock. This is followed by another stretch of sand, over which the line runs in a straight line for 3 or 4 miles, until it enters a more agreeable country, in which grass and trees are plentiful, and reaches a Wady draining some extensive hills running east and west, which is the direction taken by the Wady itself. At this part of the line gazelles are very numerous, the country between Jebel-el-Sergam and the wells of Abou Daleah containing perhaps the greatest number. After passing the Wady, the nature of the ground rendered it advisable to try several alternative routes for the line, but it was ultimately found that the camel track, with some few exceptions, offered the greatest advantages, and gradients of 1 in 75 over the rising, and 1 in 70 over the falling ground were