

solicited an intervention that should put it in his power, not to desert equatorial Africa, but to defend his authority and perhaps to reconquer all or a part of the Soudan. Stanley did not hear with such an ear.

When, at the end of 1888, Stanley returned from his point in the camp of Barttelot, weary, feeble, and enervated, he maintained that Emin should consider himself released from all obligation toward his troops by the revolt of which he had been the victim. Emin, with a little of German sentimentality that he owes to the Schnitzler blood that flows in his veins, and with much of the noble stoicism of the captain who wishes to be the last to abandon his ship, dilly-dallied, contradicted himself, renewed the day after the promise of the day before, and in reality did not wish to leave if it were possible to stay; at all events, he wished to take all his people with him, from the daughter that he had in the Soudan by an unknown mother up to the last of the slaves of the last of the Egyptian effendis under his orders.

Stanley, clear headed and resolute, who has reduced for himself all the *impedimenta* of sensibility, and who does not willingly suffer obstacles, especially on the part of another's will, shrugged his shoulders and intimated that Dr. Schnitzler was afflicted with that peculiar form of folly which he called the Soudanese mania, and of which, according to him, Gordon was one of the most illustrious victims; and he went on with his preparations.

In order to appreciate what there was of just and noble in the hesitations of Emin, it suffices to remember the heroic Gordon shut up in Khartoum and writing in the journal which is the incomparable legacy of his last days an indignant protest, superlatively ironical and eloquent, against the idea suggested to him by the British agent at Cairo, of buying his safety through the abandoning of the Egyptian garrisons. And in the present case it was not solely a question of leaving soldiers behind him. It was the last remains of the civilizing work in the Soudan that it was necessary to overturn with his own hands. So long as the equatorial provinces, those regions in which Gordon inaugurated his beneficent reign upon a more modest scale in the Soudan, remained in the hands of an Emin, mahdism had not penetrated everywhere. There remained one strong hold of civilization in the very heart of Africa, and it was always possible to seize the mahdist bands unawares and crush fanaticism anew in its nest. This was the mental reservation that had dictated to Emin his appeals to Europe. He saw himself resupplied with provisions and ammunition, and relieved, and not only placed firmly in the saddle in his government, but capable of running down the enemy which was menacing Egypt and holding the Soudan.

So it is in Stanley's narrative that we must read of the surprise and disenchantment that possessed him when he learned what was desired of him. The Egyptians, who saw their chief irresolute, who dreaded a change of residence, and who had but little faith in Stanley's mission, soon lost respect for and obedience to the governor, and deposed and imprisoned him. Whatever resolutions Emin may have made for the future, it was all up with his authority, and, consequently, with his usefulness.

Emin, however, was not exactly the first comer. He took his degrees in the school of lofty soaring adventurers, just as Stanley himself did. By turns the physician and confidant of an Ottoman pasha, then the husband of a rich and mature Osmanli beauty, an itinerant naturalist in Africa, then a physician to Gordon, who did not believe much in medicine and the profession of it, next lieutenant of the viceroy of Khartoum, then governor of the equatorial provinces, he was able, after the defeat of Hicks Pasha had shaken the Egyptian domination and Gordon's disaster had destroyed it, to maintain these vast regions under his authority, which was after all purely moral. While his old colleagues, Lupton and Slatin, fell into the power of the Mahdi and had to buy from the mission of the false prophet the right to spend the rest of a miserable life in chains, Emin, up to the arrival of Stanley, opposed a firm rampart toward the south to the progress of fanaticism. To-day, the bulwark is destroyed. Omar Saleh, the sheik who figures with so little honor in Gordon's journal, had trouble in conquering even the lieutenants who revolted against the Austrian pasha.

We here see the bond that connects with reality the fantastic stories told by Osman Digma to General Grenfell upon the march, and the battles of the white pasha in the Bhar-el-Gazelle. The Mahdists advance, intoxicated with their victories, and especially with the miracles by which Allah had confirmed the mission of their prophet, that is to say, the green sun that was to exhibit its sinister brightness in the heavens before the manifestation of such or such an envoy from God, and which the dust from the eruption of Krakatoa made appear at the desired moment, and those aigrets of fire which sparkled at the point of the arms of the true believers, and in which European science sees a phenomena analogous to that of St. Elmo's fire.

As regards this march, the civilized world will ask whether it was indeed worth the while to run so many risks, to undergo so many fatigues, to spend so much money, to end so many lives, to strew the dark forest footpaths of the Ituri with so many corpses, in order finally to efface the last vestige of Gordon's empire. Assuredly, it is something to say: The man is saved, Emin is alive. But it is hard to have to add: The work is destroyed, the entire Soudan remains Mahdist. Nothing will be able to compensate for that misfortune.

It is thought that Stanley will not return at once to Europe. Instead of going to enjoy a well earned rest, it will be a question for him to accept, at Mombassa, in the territory submitted to English influence, duties analogous to those of Major Wissmann from Bagamoyo to Mpuapua. Invested with the authority of British commissioner, Stanley would have the founding of the English domination in these regions upon solid and extensive bases, and of putting German pretensions slightly in the shade.

Between a Stanley and a Wissmann the disproportion would be glaring.

It is to be regretted that, from the standpoint of humanity, there is no great difference between Stanley, who has never professed an inviolable respect for the life and liberty of the natives, and the German major, who has all the brutality that his compatriots are ever ready to use toward conquered populations. Politically,

such an enlistment, even provisional, in the service of the British Society of East Africa would be a very great affair and of much consequence. It would remain to be seen whether Stanley would consent to play the role of conqueror for Sir William MacKinnon and his colleagues, and whether he would succeed in checkmating the greedy and ill-advised ambition of the Germans.

While professing a more than limited sympathy for the enterprises of Germany, we will be excused as a Frenchman for feeling some inquietude on the subject of the insatiable appetite of England, which, *vide* a recent article in the *Times*, has its eye upon nearly the whole of the Dark Continent, and has the pretension to weave a compact and uninterrupted network of British possessions from the Delta to the Cape.

There is room for everybody in Africa, even for the Africans, and it would be degrading for a man like Stanley to make himself the instrument of a plan of conquest instead of continuing to serve science and humanity solely.—*F. D. Pressense, in L'Illustration.*

To conclude, we give a few biographical notes concerning Stanley:

John Rowland, better known under the name of Henry Moreton Stanley, is, as says the *Saturday Review*, the Napoleon of the special correspondents of American journals and of the explorers of Africa. He was born at Denbigh, in Wales, in 1840. After a youth spent in poverty, he succeeded in obtaining a position as a reporter on the *New York Herald*, and made his first exploits in Abyssinia in 1867, in following the English expedition led by Lord Napier. The circumstances under which he was unexpectedly ordered by Mr. James Gordon Bennett, in 1870, to go to the center of Africa in search of Livingstone, whose fate was then greatly attracting the attention of the Anglo-Saxon world, are well known. On the 3d of November, 1871, Stanley met with the illustrious missionary at Ujiji, on the banks of Lake Tanganyika.

In 1875, the *New York Herald* and the *Daily Telegraph* commissioned him at their joint expense to traverse Africa from east to west. The discovery of the Upper Congo was the fruit of these three years of travel. Stanley has since then served the King of the Belgians in the new state. Three years ago he started for the relief of Emin. He may be truly called the king of travelers. He has, it would seem, a charm, a magic amulet, which preserves him from the dangers to which his rivals would easily succumb.—*F. De P.*

EARTH TREMORS.

By HERBERT A. HOWE.*

DURING the month of October, last year, some experiments were made at University Park, a suburb of Denver, to determine the effect of vibrations of the earth caused by trains, teams, and men, on images reflected from a mercurial horizon. The reflected images of objects on the roofs of houses were watched with the naked eye, and also through the telescope of an engineer's transit made by Fauth & Co.; the magnifying power of the latter was about twenty diameters. The observing station was 1,500 feet away from the Denver, Texas, and Gulf railroad, and 500 feet from the Denver and Santa Fe (narrow gauge). The soil is a loam several feet deep, and was very dry, the surface being quite hard.

Below is a summary of the results.

1. When a man weighing 135 pounds jumped up from the ground six inches, and came down on his heels, the reflected image quivered, if the man was not more than 125 feet from the mercurial horizon.
2. A team of small horses attached to a light wagon, and driven at a slow trot, caused disturbances which vanished when the vehicle reached a distance of two hundred feet from the mercury.
3. A pebble half as large as one's thumb, dropped one-eighth of an inch at a distance of one foot, made the reflected image tremble perceptibly to the naked eye. When the pebble was dropped similarly and repeatedly on a little heap of loose earth, no vibration was detected until the earth became packed. The image seemed to leap away from the point where the pebble struck.
4. Denver and Santa Fe trains did not shake the image, probably because they ran slowly in approaching the depot.
5. Passenger trains on the Denver, Texas, and Gulf made more marked tremors than freight trains of much greater weight. Though the amplitude of vibration of the image was not great, it was seen to increase as the trains approached and to die away as they receded.
6. The horizon was placed on the ground at the bottom of a rectangular excavation six feet deep, sixteen feet long, and two feet eight inches wide, which was surrounded by a twelve inch stone wall. The transit was above, its tripod resting on the natural surface, and the reflected image was that of the cornice of a house. Pebbles of various weights were dropped repeatedly a distance of three feet, striking on the natural surface near the instrument. The point of striking was eight and a half feet from the mercury [six feet horizontally and the same distance vertically]. Some of the pebbles caused no tremor that could be seen, others a slight one, and the heavier ones a very marked quivering.

The horizon was then placed on the natural surface at a distance of eight and a half feet from the point where the pebbles struck the ground. The same pebbles were again dropped from the same height, but no shaking of the image could be perceived. When, however, they were dropped at a distance of six feet from the horizon, the disturbance of the image was a trifle greater than when the horizon was at the bottom of the excavation.

7. The horizon was set on top of the stone wall surrounding the excavation, and the pebbles were dropped on the wall at a distance of six feet from the mercury. The tremors were much stronger than before.

8. Two pieces of iron, weighing respectively one and two pounds, were dropped from different heights at various distances from the mercury; the weights were dropped, in each case, at such distances that the vibrations caused were barely perceptible. A discussion of these revealed the following law:

The intensity of vibration varies directly as the po-

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tential energy of the suspended weight, and inversely as the square of the distance between the mercury and the point of striking of the weight.

These observations seem to show that greater gain is to be expected from placing the piers of instruments at a distance from disturbing influences than from sinking their foundations deep in the earth. They are somewhat at variance with the first page of Loomis's *Practical Astronomy*.—*Sidereal Messenger.*

FENCE WALL GEOLOGY.

By AUG. F. FOERSTE.

IN drift-covered areas actual exposures of bed rocks are often insufficient in number to determine even the simpler problems of geology. In such cases any assistance derived from other sources is often of value. In regions where the drift near its surface contains boulders sufficient in size and abundance for the construction of fence walls, these boulders will often furnish the desired data. Since such boulders are placed in fence walls as a rule in the most expeditious manner consistent with the clearing of the adjoining fields, they have usually been removed too short a distance from their position in the fields to seriously affect any investigation as to their distribution. Moreover, an examination of the neighboring topography, the slope of the lands, the presence of streams and ponds, and similar data, will frequently even make their original position in the fields quite certain. The existence of fence walls also implies the existence of boulders in sufficient numbers and of sufficient size to insure the observer that their original location, while a part of the bed rock, is not too far distant to make a study of their distribution profitable. The study of fence walls, therefore, becomes the study of the larger elements of the drift.

It is well known that near their source in the bed rocks the elements of the glacial drift are quite angular, but that owing to attrition the corners and edges are gradually blunted or worn off as their distance from the source increases, until finally the fragments become quite decidedly rounded. All this is of course accompanied by decrease in size. With a further increase of the distance from the original source the size of the boulders becomes too small even for use in fence walls, and the further increase of distance is therefore also noticed by the smaller percentage of such boulders found in the fence walls. This smaller percentage may also be due to another cause. For while the greater percentage of boulders travel along the path of the glacier (or with its gradient) a considerable percentage deviate from this course; many 5, some 10, and a few as much as 15 degrees, thus affecting the percentage of such boulders in the fence walls. Knowing the direction in which the glacial drift moved from the scratches it left on actual exposures of bed rocks, it is possible by means of an examination of the relative degree of angularity and size of rocks, the frequency of their occurrence in the fence wall, and a study of their distribution, to trace boulders back to their original source.

It is evident that the study of very angular boulders is alone of direct value in determining the original position of any class of rocks, since these alone lie near their original source. A record of the remaining boulders of the fence walls is, however, of value in determining their probable distance from the original source, and in guiding future search. When boulders are derived from rocks maintaining their lithological and paleontological characters over wide areas, the angular boulders derived from one locality within this area will be mingled with the more or less rounded boulders from some other locality in the same area, so that careful records are always of value in reaching accurate conclusions. Note taking is chiefly confined to recording the varying percentage of the various rocks forming fence walls and their degree of angularity. A record of their size, in addition to that usually already indirectly expressed in a record of their percentage, is usually of less importance.

The distribution of the very angular rocks will determine the form of the original area, whether the exposure was local and limited in all directions, formed a long narrow band, or covered a wide and extensive area. It will be of some assistance in this work to remember that the limits of any formation in going against the glacial gradient are near the line of more or less abrupt disappearance of all boulders derived from that area, and that the limits of the same area on the side with the gradient are best determined by the similarly sudden appearance of boulders of a different character. As the boundaries of any area approach parallelism with the glacial gradient, boulders of nearly the same degree of angularity but derived from different sides of the boundary will become intermingled, so that in such cases the determination of the boundaries becomes more conjectural.

Studies based upon preceding principles having led to a rough delineation of the area formerly occupied by any class of rocks, it becomes necessary to correlate this area as determined by boulders more closely with the area exposed by the bed rocks during erosion. For this purpose recourse is had chiefly to topographical features.

The most common of these are differences of elevation between two adjacent areas geologically distinct, due to the frequency with which rocks of different geological ages show different degrees of resistance to the action of erosion. This is likely to result in the formation of single hills when the original area was a boss of some igneous rock; long, narrow broken ridges or valleys when the original area was long and narrow, whether sedimentary or igneous in origin; flattened or much diversified areas of greater extent but of marked difference in general elevation when the original areas were of considerable extent. In such cases the boundaries between neighboring formations are apt to be found nearer the base of the hills or the top of the sides of the valleys expressive of the variable resistance offered to erosion by the different geological formations.

Any abrupt change in the character of a rock, from a sandstone to a conglomerate, a shaly series, an igneous formation, and the like, is a potential line of weakness. Owing to a variable degree of hardness and tenacity the rocks along such planes are apt to become separated during folding, and a moderate amount of sliding or faulting may take place on these planes, and give rise to additional fractures along the plane of