SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MAY 24, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

VOLCANIC ERUPTIONS AND THE ISTHMIAN CANAL.

Outside of the lessons of the Martinique disaster that are obvious and applicable to the world at large, this truly horrible convulsion that wiped out a city in a few brief moments carries a special warning for the people of the United States. We refer to the profound importance which is given to the question of seismic and volcanic convulsions as affecting the costly canal which the government is about to construct across the Isthmus.

Of the two possible routes, Panama and Nicaragua, there can be no question, with the red ruin of Pelée before our eyes, that choice must be made of that route, which present physical conditions and local tradition and history prove to be the least threatened with volcanic convulsions.

The situation at Panama may be summed up in the statement that the Isthmus has not been modified since ages before man appeared on the earth; that no trace of volcanic agency can be found there; and that there is within 180 miles of the canal no volcano even of the extinct variety. Nicaragua, on the other hand, has always been a center of seismic disturbances; its route is lined with, or closely approximate to, volcanoes, some of which have shown evidence of tremendous latent energy. Only sixty-four years ago Cosequina, in the northwest of Nicaragua, belched forth for two whole days a mass of matter, that in every six minutes of the eruption, according to M. Buneau-Varilla, would have equaled the whole mass of material to be dug from the Nicaragua Canal. The roar was audible a thousand miles distant, and ashes fell fourteen hundred miles from the Isthmus. Seven years later what is known as "the great earthquake," completely destroyed the city of Rivas, which is only five miles from the Pacific terminus of the canal, and seriously damaged Greytown, the Atlantic terminus.

Comment on these facts is unnecessary, and we do not doubt that the former advocates of a canal at Nicaragua will decide, in the presence of this awful cataclysm at St. Pierre, that the location of the canal in such a center of volcanic action as Nicaragua is simply out of the question.

HAVANA TRANSFORMED.

From one of the most disease-stricken ports in the world, Havana has now been converted into a charming tropical city—a result which has been due entirely to American enterprise in Cuba. What a wonderful sanitary change has been wrought in the old town is graphically told by Major W. M. Black, in the National Geographical Magazine.

Shanties and sheds that had been for decades breeding places for cholera germs were ruthlessly swept away; streets never repaired in the memory of living man were cleaned or repaved; sewers were rebuilt; and houses were unceremoniously entered and disinfected. All this work has been done, not spasmodically, but systematically. Cleaning squads were sent from house to house; apartments were cleaned regardless of the protests of their inmates. The accumulations of years from cellars were thrown out. Such an arbitrary procedure would, no doubt, raise a storm of indignant protest from the people of North America. But the health and safety of Havana demanded it.

The most admirable work of all was the cleaning of the sewers. Not since the day when they were first built had they been looked after. Many of them were choked by the refuse of decades. The American authorities not only managed to repair the sewer system and render it in every way serviceable, but did so without injuring the life of a single laborer. The streets of the city have been cleaned, and in many cases transformed. Narrow thoroughfares have been widened. A magnificent sea wall and a promenade have been built; parks have been cleared and converted from haunts for thieves into pleasure grounds for the people.

The worst pesthole in Havana was the Hospital Militar. To be carried to that place was like being carried to one's grave. Not more than 30 per cent of the patients who entered its walls ever came out alive. American surgeons avoided it; soldiers held their breath when they passed it. The sanitary squad of the Engineer Corps took possession of the building, cleaned it from attic to cellar, coated its walls again and again with whitewash, and finally left the building clean and wholesome. It is now used for a schoolhouse.

Naturally the slothful Cubans disliked the fumigation and disinfection process to which they were subjected. What was good enough for their grandfathers was good enough for them, they thought. Probably most of the Cubans, if the matter of cleaning the city had been put to popular vote, would have decided against the transformation of the town. Now that the streets are cleaned, the parks trimmed and lighted and the sea promenades enjoyable, they have revised their opinions of American extravagance and have even begun to take a certain pride in the new capital. What the effect of the sanitary improvement of the city has been is easily proven by a comparison of the vital statistics in past years. In 1896 no less than 1,262 deaths from yellow fever alone were reported to the city government. The average for the eleven years preceding American occupation was 440 fatal cases. Last year, for the first time in the history of the city, the yellow fever season passed without five fatal cases of the disease. October, November and December, the three months in the year during which the fever was the worst under Spanish rule, passed without a single case.

LIQUID FUEL FOR STEAMSHIPS.

But a few years ago a serious discussion of the possibility of the general substitution of liquid fuel for coal on steamships and locomotives was out of the question, for the reason that the output of oil was inadequate to the supply of more than a very small percentage of the world's steam tonnage. In proof of this it is interesting to refer to the experience of the Pennsylvania Railroad, when the rapid development of the Pennsylvania and Ohio oil fields led to an investigation of the possibilities of oil as a locomotive fuel. While the engineers of this company were engaged in designing the best form of firebox and apparatus for burning oil it occurred to someone to make an estimate of the total amount of oil which would be necessary to run all the locomotives on that great system. The result showed that they would consume more oil than the total output of the United States oil fields of that date.

Although there have been extensive discoveries of oil in various parts of the world, and a great development of special fields such as that at Baku, Russia, the question of the widespread use of fuel oil for locomotives and steamships was governed, up to three or four years ago, by the very limited supply. The government report on the subject for 1901 gives the total output of petroleum for the whole world in 1900 as 155,000,000 barrels. The production in the United States for the same year was 63,000,000 barrels; but in 1901, as the result of discovery and exploitation of the Texas oil fields, the output went up 1,200 per cent to 720,000,000 barrels. There has been an enormous increase also in the world's production, due to the remarkable oil fields in Borneo and Burma. It is impossible to estimate with any accuracy the present world's output, but that it is sufficient to make the supply of oil comparable with that of coal is seen when we bear in mind that to-day there are at least 250 wells in the Texas oil fields alone, which up to last week have shown a flowing capacity of from 50,000 to 160,000 barrels per day. From this we see that during the "gushing" period the rate of output, assuming an average yield of say 25,000 barrels per well, would be equal to a yield of something like two billion gallons per year from the Texas oil fields alone. The gushers, however, are subsiding, and the oil will ultimately have to be drawn out by pumping; but, even allowing for this, it is evident that the oil wells of Texas, California, Borneo and Burma, the four new fields, will yield enough oil to render the general use of liquid fuel in the steamships of the world quite a possibility.

Having eliminated then the question of the scarcity of fuel, it can be said that, looking at every other possible condition of cost, bulk, fuel value, ease of storage, economy of space and wonderful convenience of manipulation in firing, there is everything to be said in favor of liquid fuel at sea. The experience already had with crude oil proves that there is as much fuel value in two tons of oil as in three tons of our coal at $3.50 a ton, and it is found that oil takes not much more than half as much space, weight for weight, as coal, 40 cubic feet of oil being equivalent to 70 cubic feet of coal. As regards the relative cost of the fuels, taking $3.50 as the average price per ton of steam coal as delivered in the bunkers in New York, we find that Texas oil, to compete with this coal, must be delivered on board at about 75 cents per barrel.

There are strong indications that before long fuel oil will be available for steamships in New York at this price and possibly for something less. The question that is confronting the owners of the Texas oil wells is not how much oil is available, but how to get the oil out fast enough to supply the demand. In spite of all the efforts that have been made, the consumption for the past few months has only been a fractional part of the capacity of the wells, a large number of which have been capped and are only awaiting increased transportation facilities by rail and sea before they are opened either to flow by natural pressure or be drawn upon by pumping. The railroads are making heroic efforts to transport the oil, and there are now several large tank steamers under construction at the various Atlantic shipyards. A number of pipe lines have been built from the wells to Port Arthur at the mouth of the Sabine Pass, and it is probable that within another twelve months the shipments from Beaumont will have increased enormously. As to the price at which the oil will be delivered in New York, it is difficult to predict with any certainty. There is a charge of ten cents per barrel for carrying oil through the pipe lines to Port Arthur. At the wells oil is selling as low as six to eight cents a barrel, and there is a rate of forty-five cents per barrel from Port Arthur to New York city for tank steamers. At that rate the actual cost at present of the oil delivered in this city would appear to be something over sixty cents a barrel.

It would seem, therefore, that fuel oil to-day could be sold at a profit and yet compete in price with steamer coal, the two fuels standing in this respect upon an equal footing. The enormous advantages of fuel oil, however, become manifest at once when we consider the question of storage in the ships and use in the furnaces. Thus, taking such a vessel as the "Kronprinz Wilhelm," which carries about 4,500 tons of coal in her bunkers, we find that instead of 4,500 tons of coal she would require on the basis of two to three only 3,000 tons of oil, a clear saving of 1,500 tons of dead weight. On the basis of bunker space allotted, there would be a saving of about 90 per cent, and this in a high-speed express steamer like the "Kronprinz Wilhelm," which can carry at the best probably not more than 500 or 600 tons of freight, when running with coal, would be of enormous value; for the fuel oil has this great advantage that it can be stored in the cellular double bottom of the ship, leaving the entire bunker space for increased stores and cargo. Furthermore, the use of oil would cause an immediate and very great reduction in the boiler room staff. There would be no need of an army of coal passers and firemen; for the oil burners, when once started, require nothing more than the intelligent oversight of a few first-class firemen whose duties would be rather those that fell to an engineer of the lower grade. It is estimated by Mr. Clement A. Griscom, of the American Line, that by the use of fuel oil on their ships the boiler room staff could be reduced 80 per cent. There are, moreover, other subordinate but very important advantages arising from the use of fuel oil, such, for instance, as the great ease and cleanliness of taking the fuel on board, for it would flow into the double bottom through pipes by gravity, and there would be none of the objectionable dust and dirt which is inseparable from coaling a vessel. As to its convenience for a ship on an extended journey, there are at present over thirty localities throughout the world where the fuel is stored and may be secured, and the number of storage stations will multiply rapidly as the fuel comes into more general use.

FUSION OF QUARTZ.

Some interesting experiments in connection with the fusing of quartz have been carried out with great success by Mr. R. S. Hutton, of the Owens College, Manchester. Quartz is much preferable to glass for the manufacture of certain physical apparatus, especially those of a delicate nature, and those required for high-temperature gas investigations, but its application is very limited, owing to the great difficulty of fusing it. Hitherto the oxyhydrogen blowpipe only has been used for fusing the quartz, but its success is not very complete, owing to the fact that the temperature thus generated is only a little higher than the melted silica itself. This fact led Prof. Moissan and other prominent French scientists to achieve the desired end by the utilization of the electric furnace, but their researches did not accomplish so great a result as was anticipated. Mr. Hutton, however, was convinced that the electric furnace was the only means by which the silica could be reduced to a molten condition, and he thereupon conducted his experiments upon the lines of Moissan, and some interesting effects of the arc upon the silica were observed. The most salient advantage that molten silica possesses over glass is that it may be plunged into cold water, no matter to what