that such feature should be added to their device, the case cannot be said to come within that class of cases where the seller of parts of a patented combination is liable for infringement if there be a concert of action proved or legally inferable between him and others who supply others parts necessary to the complete combination.

Bill dismissed.

AMERICAN INDUSTRIES.—No. 54.

THE MANUFACTURE OF ULTRAMARINE.

Ultramarine is a blue pigment, used extensively for paint, bleaching paper, printing calicoes, paper hangings, staining paper, blue printing ink, laundry blue, and various other purposes. Its shades run from a very light greenish blue, through light and dark clear blue, to a very deep pinkish blue. There are also green, violet, red, yellow, and white pigments of nearly the same composition, the two latter being mere curiosities.

The chemical composition of this color is not yet fully understood. The generally accepted theory is, that alumina, silica, soda, and brimstone enter into a combination, forming an aluminous silicate, and thus combining with the meanwhile forming sulphuret of soda produces the ultramarine. It is entirely free from poisonous substances, resists the action of alkalies to a high degree, is very permanent in air and light.

White lead changes under its influence to a dull brown, and should never be used with it, oxide of zinc being far preferable. It loses its color gradually if in contact with acids. It was formerly made from "lapis lazuli," an opaque blue stone, which is found in some parts of Europe, Asia, and South America. The lapis lazuli was pounded into pieces of the size of a hickory nut, calcined, and washed with water and vinegar. This process was repeated several times, until the stones could with ease be crushed to a fine powder. This was mixed with a paste of turpentine, rosin, wax, white pitch, and linseed oil, and kneaded thoroughly through a bag under water. The blue washed out through the bag was collected on filters. It was sold, according to quality, for $50 to $200 per pound, and consequently could not be of general use.

In 1814, lumps of a blue pigment were found in various soda furnaces in France and Germany, and the chemical analysis disclosed the fact that they were of nearly the same composition as lapis lazuli, the natural ultramarine.

In 1824, the Société d'Encouragement of France offered a prize of 6,000 francs for the artificial production of ultramarine, provided its price should not be above 600 francs—about $20—per pound. Guimet, of Toulouse, in 1828, succeeded in producing an artificial ultramarine of a very fine quality, and received the prize. He kept his process a secret, and, although the price sank rapidly to as low as $3 to $4 per pound, he grew immensely rich, producing, in 1834, at the rate of about 120,000 pounds a year.

At about the same time, and, as is positively asserted, prior to Guimet, Gmelin, of Tubingen, made the same invention, and published his researches in full, thus probably causing the supremacy of Germany in the manufacture of this beautiful pigment.

The first factory started in Germany was that of Leverkues, in Wermelskirchen, on the Rhine, in 1834; the second in Nuernberg, in 1838, by Leykauf & Heine. To-day there are thirty-four ultramarine factories in the world, producing about twenty millions of pounds annually. The establishment which we describe to-day ranks as the third in extent and importance, and furnishes about one-tenth of the entire product.

Up to 1869 several unsuccessful attempts had been made to manufacture ultramarine in the United States. The failure was attributed to the prices of labor, rent, and chemicals, which were much higher here than in Europe. In the fall of that year Messrs. Heller & Merz set up their machinery in a building, 50 x 125, in Newark, N.J. Success was the true companion of their energy, and in 1873 they bought a large tract of land at the eastern limits of Newark, N. J., and there erected new and extensive works, which have been gradually enlarged until they cover three acres of ground, comprising seven large buildings and several sheds, stables, and dwellings. The works are driven by two engines of 100 and 50 horse power respectively, and one hundred workmen are employed. A new engine of 250 horse power and two new boilers have lately been set up, and the old ones will remain for unforeseen emergencies.

In the process for the manufacture of ultramarine the following ingredients are used: 1. Kaolin (china clay), Glauber salt, and coal, or rosin. 2. Kaolin, soda, silica, sulphur, and rosin. 3. Nos. 1 and 2 mixed with or without silica, according to the desired shades.

The raw material must be ground by burrstones to an impalpable powder, thoroughly mixed, pressed into large crucibles or muffles, and calcined to a red heat in furnaces for from 12 to 36 hours, as the various qualities require. The firing is finished when the sulphur is nearly burned out. This operation must be watched very closely through holes in the brick work of the furnace. When the firing is completed the furnaces are closed nearly air-tight, and the material allowed to cool off. This will take from five to six days. On opening the furnace the material appears dark green when Glauber salt has been used. With mixtures 2 and 3 the color is a very dark blue. The green ultramarine must be roasted with finely powdered sulphur in pans or retorts under influx of air, to produce the lightest shades, which are called cobalt ultramarine. Either kind must be thoroughly washed, as large quantities of Glauber salt and sulphureted soda are formed. After the washing the ultramarine is ground in wet mills from two to five days. When the grinding is finished the pulpy mass is run into large iron tanks, where it is refined under the influence of heat and various chemicals, then repeatedly washed in large vats, and, after separating the various grades of fineness, dried in ovens, bolted, and packed.

The qualities of ultramarine made by Messrs. Heller & Merz are to-day, with the exception of a very few unusual brands, good as any imported, and their product always finds a ready market. Their share of the world's business in ultramarine is much larger than a statistical record will make it appear, for in Europe more than one half the ultramarine sold is adulterated to an incredible extent, while American consumers are looking sharp for a pure article. Thus, factories in Europe claiming a sale of 10,000 cwt., may, in fact, not produce more than 5,000 cwt. of pure ultramarine.

The chemical qualities of ultramarine are of importance only when used by paper manufacturers. They use it for giving the paper a white or bluish tint, but as the alum, which is used in treating paper materials, causes an acidity, which tends to destroy the ultramarine, it must be made to resist this action. This is done by the use of larger quantities of silica in the raw material, yet ultramarine can never be made entirely acid proof.

The product of Messrs. Heller & Merz is much more alum-proof than any of the European ultramarines. The alum test is made by exposing equal quantities of different samples of ultramarine, say five grammes, to the action of equal quantities, say two ounces of a saturated solution of alum, in test tubes. The chemical action will soon set in, particularly when the tubes are put in warm water, sulphureted hydrogen will evolve, and the ultramarine will change its color to a light blue and gray. The sample holding out the longest is the best for paper, *i. e.*, if the coloring strength is even. The coloring strength is tested by mixing equal quantities of ultramarine with about ten times its weight of finely ground barytes or gypsum upon paper with a palette knife, taking great care to weigh the quantities very exactly, and to not press too hard with the palette knife. The sample showing darkest when thoroughly mixed is the strongest, taking in consideration its bluish or reddish shade.

For laundry purposes ultramarine is generally put up in balls. It is thoroughly mixed with small quantities of an adhesive substance, such as gum arabicum, dextrine, starch, and is worked into a thick dough, rolled flat, cut into square blocks, and rolled by hand into balls. This work is generally done by children. Ultramarine is a better bluing agent than either soluble blue or aniline, on account of its more beautiful tint and its bleaching power. Prussian (soluble) blue particularly will impart to clothes a yellowish rusty tint after continued use. In using the ultramarine for this purpose it should be strained through a fine cloth and not allowed to settle lest it should spot. The price of ultramarine ranges from 10 to 30 cents per pound in large quantities, and some extremely fine qualities as high as $1. Violet ultramarine is made by exposing unground blue ultramarine to chlorine gas under high temperature, and red by exposing violet under low temperature to diluted nitric acid vapors. Both kinds are sparingly used.

Since the beginning of the manufacture of ultramarine in the United States the price has constantly declined, and it sells now at a much lower figure than formerly in spite of the higher duty. Prejudice and too much conservatism kept it out of the market too long, but now it is used in most places in preference to the imported article, on account of its even running qualities, its lower price, and on account of the responsibility of the manufacturers.

The large engraving in our present issue accurately represents the American Ultramarine Works of Messrs. Heller & Merz. The buildings occupy a ground space of three acres, the inclosure being 350x600. There are two distinct factories for the full process of ultramarine. In the front are small dwellings, which are omitted in the picture for the sake of clearness. The first building is 60x150, and the second 75x160. In the covered space between of 100 feet are the main factories, which are being rapidly filled with mills and furnaces. The engine house contains the large engine, two boilers, and a completely fitted up machine shop, where two machinists, with their attendants, attend to the new and repair work of the factory all the year round. The last building on the front line 100x75 is the paint shop where the blue paint used by oil refiners in painting barrels is ground. This, by the way, is quite a large business with this firm. On the rear line are sheds for bulky raw material, the cooper and carpenter shops, and the large store house, 160x60.

One of our views shows the dry mill room where the raw material is ground on 14 sets of burrstones, while another represents the furnace house. There are twenty furnaces, with a capacity for 30–75 cwt. of ultramarine, such large furnaces being quite a novelty in this branch. There is also a pottery connected with this establishment for making crucibles, of which this firm uses about 75,000 per annum.

One of the larger views represents the room for washing, grinding, and refining ultramarine. There are for this purpose eight large wooden tanks holding about 40 cwt. of ultramarine each, and 120 wet mills set up in rows. A large number of iron tanks and vats, also 72 wet mills, are in process of erection, and will, with an increased number of furnaces, raise the capacity of these works to 30,000 cwt. per annum.

One of the views shows the bolting and packing room, in which the men, with their clothes saturated with blue, present quite a novel spectacle. The ball blue room is also represented. Here about one half the ball blue for the United States is manufactured. The interior of the paint shop is also shown in the engraving. The consumption of chemicals in this establishment is very large—about 2,000 tons per annum. The space where these works now stand was formerly a swampy, fever-and-ague ridden spot. Dwellings are drawing nearer every year, giving the place the appearance of quite a little town. The continuous filling up of ground, and the extensive use of brimstone, which distributes large volumes of sulphurous acid gas, seem to have a very salutary effect. Fever has disappeared almost entirely, and the men look strong and robust. The salesroom of Messrs. Heller & Merz is located at 55 Maiden Lane, New York city.

English Fast Trains.

A correspondent of the *English Mechanic* writes as follows: A great stride seems to have been made, at the commencement of this half year, by all our railway companies, in the matter of speed, notably by the M. R. and G. N. R.

Some of the results attained by the latter are wonderful. The "Scotchman" will be quite in the shade shortly.

There are no less than eight trains daily, running from King's-cross to Grantham, 105½ miles, without a stop, and without picking up water, in 123 and 128 minutes each. In the case of the Leeds expresses, the speeds further on are yet more surprising.

From Grantham to Doncaster is 50½ miles, which distance is covered several times a day, without a stop, in 61 minutes.

From Grantham to Wakefield there are 73 miles, which are accomplished by the 6:30 P.M. down, *in 77 minutes.* This last run is at a speed, therefore, of 56·88 miles per hour.

Allowing for stoppages, this last mentioned train runs 186½ miles in 215 minutes, at a speed of 52·05 miles per hour.

Compare this with some other favorite performances. The "Dutchman" runs from London to Exeter in 4¼ hours, and stands on the road 20 minutes, thus running 193 miles in 235 minutes, or 49·5 miles per hour.

That is broad gauge; but their fastest narrow gauge runs from London to Birmingham, 127 miles, in 2 hours 45 minutes. Deduct 6 minutes, and we have running speed, 48·8 miles per hour.

Let us take a light M. R. train. The 10 A.M. from London is their best. It runs 192 miles (to Leeds) in 4½ hours, and stands 14 minutes. The speed, therefore, is exactly 45. Some of the runs, however, are very good. Sheffield to Leeds, 39½ miles in 49 minutes, means 48·5. I am not, however, quite sure that the shortened distance is as much as I have given.

Enough has been shown, however, to prove that the G. N. R. run, by a great deal, the fastest trains in the world; and not only that, but they run the greatest number of them; and also what our companies in the south might conveniently notice, is, that, with two exceptions, all convey third-class passengers in a state of luxury which second-class passengers on less favored lines might envy. Between London and Peterborough, and *vice versa*, there are daily 37 trains, doing the 76 miles in an hour and a half, more or less.

The good town of Leeds, of which I am a native, cannot but congratulate itself on the excellent catering of the M. R. and G. N. R., which has finally resulted in 19 express communications with the metropolis, each way daily. A minor point, worthy of notice, is that the L. Y. R. are waking up, and will seriously imperil the L. N. W. R. traffic between Leeds and Manchester, unless they wake up too.

Dry Fog.

It has been frequently noticed that during fogs near large towns the air is not saturated with moisture, the dew point in one instance being as much as 10° C. below the temperature of the air.

Seeing the possible connection between this phenomenon and the fact that the evaporation of water is greatly retarded by its surface being covered with a film of coal tar, the author made a series of experiments on the comparative rates of evaporation of water, when freely exposed to a current of air, and when covered with a film of coal tar or of coal smoke. It was found that the film retarded the evaporation from 92·7 per cent to 66·6 per cent.

The results of these experiments point out a condition of very common occurrence, competent to produce "dry fog," while they also explain the frequency, persistency, and irritating character of the fogs which afflict our large towns.—*E. Frankland, Proc. Roy. Soc.*

The Treatment of Rattlesnake Bite.

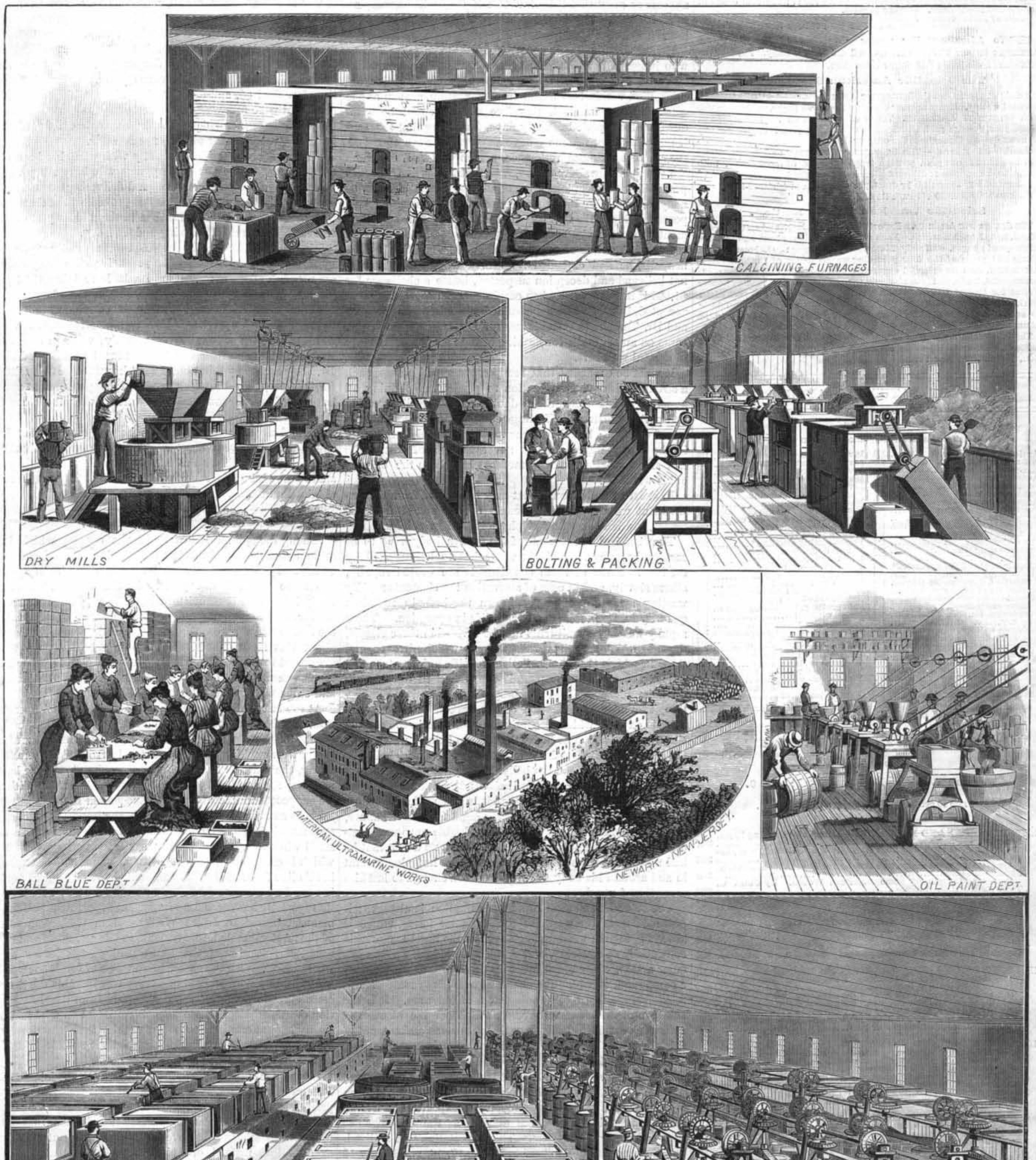
A professional snake catcher, of Holyoke, Mass., treats rattlesnake bites as follows: He first ties a cord tightly around the member bitten so as to cut off the flow of blood toward the heart. The bleeding wound is then sucked out thoroughly to withdraw as much of the poisoned blood as possible, after which strong spirits of ammonia is applied. After a while the string is loosened a little to allow the remaining poison, if any, to be so slowly absorbed into the system that no serious results are likely to follow.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLIII.—No. 8. [NEW SERIES.] | NEW YORK, AUGUST 21, 1880. | [$3.20 per Annum. [POSTAGE PREPAID.]



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