growth of about six weeks, and when gathered should be carefully cut off with a knife, not broken.

It is recommended that mushroom-beds should not be finally earthed until the spawn is seen beginning to spread its white filaments through the mass; and should it fail to do this in eight or ten days after spawning, the conditions being favorable, it is better to insert fresh spawn or to remake the bed, adding fresh materials if it be found to fail from being too cold. The temperature of the beds at spawning-time should not exceed 80° F.; 70° F. is considered the most suitable regular temperature. It is advisable not to put the spawn at any uniform depth, but so that while one piece of it may be at a depth of six inches, or nearly so, others may touch the surface. This allows the spawn to vegetate at a depth and temperature most congenial to it. Mushrooms may be cultivated in warm cellars, in boxes about four feet square by eighteen inches in depth, for family use.

MINERAL PRODUCTS OF THE UNITED STATES.

THE sixth report on "The Mineral Resources of the United States," by David T. Day, chief of the division of mining statistics and technology, United States Geological Survey, is to be issued shortly. This report is for the calendar year 1888, and contains detailed statistics for this period, and also for preceding years, together with much descriptive and technical matter. The following are the totals of the production of the more important mineral substances in 1888: —

Metals.

Iron and Steel. — The principal statistics for 1888 were: domestic iron ore consumed, about 12,060,000 long tons; value at mines, $28,944,000. This is an increase over 1887 in quantity of 760,000 tons, but a decrease in value of $4,956,000. Imported iron ore consumed, 587,470 long tons; total iron ore consumed in 1888, about 12,650,000 long tons, or 150,000 tons more than in 1887. Pig-iron made in 1888, 6,489,738 long tons; value at furnace, $107,000,000. This is an increase over 1887 of 72,590 tons in quantity, but a decrease of $14,925,800 in value. Steel of all kinds produced in 1888, 2,899,440 long tons; value at works, $89,000,000. This is a decrease from 1887 of 439,631 tons in quantity, and of $14,811,000 in value. Total spot value of all iron and steel made in 1888, in the first stage of manufacture, excluding all duplications, $145,000,000, a decrease of $26,103,000 as compared with 1887. Limestone used as a flux in the manufacture of pig-iron in 1888, about 5,438,000 long tons; value at quarry, about $2,719,000.

Gold and Silver. — According to the director of the mint, the gold product was 1,604,927 fine ounces, valued at $33,175,000. This is about the same as in 1887, being an excess of only $75,000. The silver product was 45,783,632 fine ounces, of the commercial value of about $43,000,000, and of the coining value of $59,195,000. This is an increase of 4,515,327 ounces over the product in 1887. In addition to the product of our own mines, some 10,000,000 ounces of silver were extracted in the United States from foreign ores and bullion.

Copper. — The total product, including the yield of imported ores, increased to 231,270,622 pounds, or 115,635 short tons, during 1888, which is 46,053,291 pounds more than the product of 1887. During the first quarter of 1889 the production was increasing at even a more rapid rate. The prices received by American producers averaged 15.5 cents per pound for Lake copper, 14.5 for Arizona, and 14 for other districts, making the total value 33,833,954. Montana led in the production, making 97,897,968 pounds. Consumption was somewhat reduced by the high prices.

Lead. — The product increased to 180,555 short tons from 160,700 tons in 1887. The increase was due principally to the heavier receipts of lead in Mexican silver-lead ores from 15,000 tons in 1887 to over 27,000 tons in 1888. The average price in New York was 4.41 cents per pound. The production of white lead, chiefly from pig-lead, was 89,000 short tons, valued at $10,680,000.

Zinc. — The erection of new works and the extension of old ones led to a further notable increase in the production of zinc in 1888. The additions to capacity were fairly uniformly distributed in the West, East, and South. Production in 1888, 55,903 short tons, with a total value of $5,500,855; in 1887, 50,340 tons, worth $4,782,300. The production of zinc white in 1888, directly from ores, was 20,000 short tons, worth $1,600,000.

Quicksilver. — The product was 33,250 flasks (of 76½ pounds each) from California, a decline in that State of 510 flasks from 1887, in spite of a very satisfactory price, which averaged $42.50 per flask, making the total value $1,413,125. No new valuable deposits were discovered in 1888, and without them it is not probable that the yield of quicksilver will increase.

Nickel. — The industry remains unchanged except for indications of further developments at Lovelock in Nevada, and Riddle in Oregon. The product includes 190,637 pounds of metallic nickel, valued at $114,382 at 60 cents per pound, and 4,545 pounds, worth $1,136, exported in ores and matte. Total value, $115,518. The corresponding value in 1887 was $133,200.

Cobalt Oxide. — The total product, including the contents of the exported ores and matte, was 12,266 pounds, worth $18,441. In 1887 the total was 18,340 pounds, worth $18,774, the lower rate of value in that year resulting from a larger proportion of exported nickel in matte and ore. The price of cobalt oxide remained at $2 per pound.

Chromium. — The product declined from 3,000 tons in 1887 to 1,500 tons in 1888. The average price in San Francisco remained $15 per ton. Increased operations are probable in 1889.

Manganese. — The product of manganese and manganiferous iron ores in the United States in 1888 was 239,460 tons, valued at $876,215. Of this amount, some 25,500 tons would be classed as manganese ores; the remainder, as manganiferous iron ores. Of the manganiferous iron ores, 11,462 tons averaging 11 per cent of manganese, and 189,574 tons averaging 4 per cent of manganese, were from the Colby Mine, Michigan. In addition to the above, some 60,000 tons of argentiferous manganese ores, valued at $10 a ton, chiefly for the silver contained in them, were produced in the Rocky Mountain region.

Aluminum. — The past year was more promising than ever before for the production of cheap aluminum. The production of metallic aluminum as an industry distinct from the production of alloys began toward the close of the year, and 500 pounds had been made up to Dec. 31. The production of 3,000 pounds since then indicates that the industry may continue. The exact amount of alloys produced by the Cowles process has not been furnished, but was not markedly different from the product of 1887, when 18,000 pounds of aluminum contained in bronze and ferro-aluminum were produced. The price for metallic aluminum declined to as low as $4.50 per pound for less favored brands.

Platinum. — Including the platinum and iridium separated from gold by the assay offices and that saved in placer gold-mining, the product was about 500 ounces, valued at $2,000.

Fuels.

Coal. — The total production of all kinds of commercial coal in 1888 was 142,037,735 short tons (increase over 1887, 18,022,480 tons), valued at the mines at $204,221,990 (increase, $30,625,994). This may be divided into Pennsylvania anthracite, 43,922,897 short tons (increase, 4,416,642 short tons), or 39,216,872 long tons, including 38,145,718 long tons shipped by the railroads and canals and reported by their statistician, Mr. John H. Jones, and 1,071,154 long tons sold to the local trade at the mines (increase, 3,943,430 long tons), valued at $85,649,649 (increase, $6,284,405); all other coals, including bituminous, brown coal, lignite, small lots of anthracite produced in Colorado and Arkansas, and 4,000 tons of graphitic coal mined in Rhode Island, amounting in the aggregate to 98,114,838 short tons (increase, 13,605,838 tons), valued at $118,572,341 (increase, $24,341,589).

The colliery consumption at the individual mines varies from nothing to 8 per cent of the total output of the mines, being greatest at special Pennsylvania anthracite mines, and lowest at those bituminous mines where the coal-bed lies nearly horizontal, and where no steam-power or ventilating-furnaces are used. The averages for the different States vary from 2 to 6.4 per cent; the minimum average being in the Pennsylvania bituminous, and the maximum average being in the Pennsylvania anthracite region.

The total output of the mines, including colliery consumption, was Pennsylvania anthracite, 41,624,610 long tons (increase over 1887, 4,045,863 long tons), or 46,619,564 short tons (increase, 4,531,367 short tons); all other coals, 102,039,838 short tons (increase, 14,152,478 tons); making the total output of all coals from mines in the United States, exclusive of slack coal thrown on the dumps, 148,659,402 short tons (increase, 18,683,845 tons), valued as follows: anthracite, $89,020,483 (increase, $4,468,302); bituminous, $122,497,341 (increase, $24,492,685); total value, $211,517,824 (increase, $28,960,987). The above figures show a notable increase in 1888 over 1887 in the aggregate output and value of both anthracite and bituminous coal, although not as great an increase as occurred in 1887 over 1886 in the value of the anthracite, or in the total tonnage of the bituminous coal.

Coke. — The production of coke in the United States in 1888 was 8,527,560 tons, valued at about $14,000,000. Pennsylvania produced by far the largest amount, the Connellsville region alone producing 4,955,553 tons; West Virginia, 528,533 tons; Alabama, 518,511 tons; Tennessee, 385,693 tons; and Virginia, 149,099 tons.

Petroleum. — The product of petroleum in the United States in 1888 was 27,346,018 barrels (of 42 gallons each), valued at about $24,598,559. Of this amount, Pennsylvania produced 16,491,083 barrels; Ohio, 10,010,868 barrels; West Virginia, 119,448 barrels; California, 704,619 barrels; and other States, 20,000 barrels.

Natural Gas. — The amount of natural gas consumed is given in coal displacement; that is, the amount of coal displaced by the use of natural gas. It is estimated that the amount of coal displaced by natural gas in the United States in 1888 was 14,163,830 tons, valued at $22,662,128. Of this amount, 12,543,830 tons were displaced in Pennsylvania, 750,000 tons in Ohio, and 660,000 tons in Indiana.

Structural Materials.

Building-Stone. — Direct returns from producers of the various kinds of building-stone show that there was but a small gain in value over the figures of 1887. The value of the stone produced in 1888 is $25,500,000, or $500,000 more than in the preceding year.

Brick and Tile. — Value, $48,213,000. This figure represents only a small gain over 1887. This is due rather to increase in the number of manufacturing plants than to increased production at the older and more important sources of supply; in fact, many of the latter show a falling-off in production. Prices also were generally somewhat lower than in 1887.

Lime. — The production is estimated at 49,087,000 barrels, with an average value of 50 cents per barrel, making a total of $24,543,500 as the value of the year's product. These figures are not largely in advance of those for 1887, and the gains are not so much the results of increased production in the leading lime regions as in localities of minor importance.

Cement. — The amount of cement produced in 1888 is less than for 1887, being 6,253,295 barrels for 1888, valued at 72.5 cents per barrel, making $4,533,639 as the value of the year's product.

Abrasive Materials.

Buhrstones. — The product which is used for grinding cement, plaster, paints, feed, etc., comes from New York, Pennsylvania, and North Carolina, and is valued at $150,000.

Grindstones. — Ohio and Michigan furnish practically all the sandstone from which grindstones are made. The product in 1888 increased slightly; 41,000 long tons, worth $281,800, being produced, against 37,400, worth $224,400, in 1887. The price varied from $6.50 to $10 per ton at the quarries before being finished into grindstones.

Corundum. — Production is limited to the old mines in North Carolina and Georgia: 589 short tons, valued at $91,620, were produced in 1888 against 600 tons in 1887.

Oilstones and Whetstones. — The production of novaculite from Arkansas increased slightly, making the total, including Labrador oil-stone, etc., 1,500,000 pounds, valued at $18,000 in the rough state.

Miscellaneous.

Precious Stones. — No systematic mining was carried on in search of gems in 1888; but in mining for other substances, and in chance discoveries, gems worth $64,850 in the rough state, and gold quartz worth $75,000, were found.

Phosphate Rock. — The production declined to 433,705 long tons, but the total value increased slightly to $1,951,673 on account of better prices. The trade in manufactured fertilizers was very prosperous.

Marls. — The production in the Southern States, particularly in Virginia, North Carolina, Alabama, Mississippi, and Florida, is increasing, while the product of New Jersey did not vary from 1887. About 600,000 tons, valued at $300,000, were produced.

Salt. — The industry shows only slight changes. In 1888 the production was 8,055,881 barrels of 280 pounds, valued at $4,377,204. In 1887 the product was 8,003,962 barrels, worth $4,093,846. Kansas became a commercial source of salt in 1888, producing 155,000 barrels, with a prospect of still greater increase in 1889.

Bromine. — The product was 307,386 pounds, worth $95,290, an increase from 199,087 pounds in 1887, worth $61,717. The price remained at 31 cents per pound.

Borax. — The production was restricted to 7,589,000 pounds, worth $455,340, at 6 cents per pound for the average quality. In 1887 the product was 11,000,000 pounds, worth 5 cents per pound.

Sulphur. — The sulphur-refinery in Utah was partially burned. This and litigation over the property prevented any production in 1888. The supply came principally from Sicily, with small importations from Japan. It was practically all made into sulphuric acid.

Pyrites. — Production, 54,331 long tons, valued at the mines at $167,658, a slight increase in quantity over the previous year.

Barytes. — The production from Missouri, Virginia, and New York increased to 20,000 long tons, worth at the mines $110,000. In 1887 the product was 15,000 long tons, worth $75,000.

Gypsum. — The domestic supply comes principally from Ohio and Michigan, with smaller amounts from New York, Virginia, Kansas, Colorado, California, Dakota, and Utah. The product in 1888 was 96,000 short tons of crude gypsum, valued at $430,000. A large portion of the supply is imported from Nova Scotia, where 126,118 tons, worth $121,579, were produced in 1888.

Ozocerite. — From the region of Soldier's Summit, Utah, about 20,000 pounds of crude mineral wax were produced, worth $1,000 in New York, where the material was sold. An increase is probable in 1889.

Soapstone. — Production about 15,000 tons, worth $50,000 before shipment.

Asphaltum. — The product of 1888 includes 700 tons of gilsonite mined in Utah; 3,100 tons of ordinary asphaltum, principally from California; and 50,000 tons of bituminous rock quarried in California for pavements in competition with asphaltum; total value, $331,500.

Felspar. — The consumption for potters' use declined to 8,700 long tons, worth, in Trenton, N.J., $50,000. In 1887, 10,200 long tons were produced, worth $56,100.

Flint. — For potters' use the consumption was 16,250 long tons. Including that for sandpaper and for glass, the consumption was about 30,000 tons, worth, unground, $175,000.

Potters' Clay. — The consumption included 18,000 long tons of kaolin or china-clay, 5,250 tons of ball-clay, and 13,500 tons of fire-clay, worth altogether $300,000.

Mica. — Owing principally to the use of smaller sizes in stoves, the production of sheet mica decreased from 70,500 pounds in 1887 to 48,000 in 1888, valued at $70,000. There is increased demand for mica waste.

Mineral Paints. — The product, including ochre, metallic paints, and small amounts of umber and sienna, increased to 24,000 long tons, valued at $380,000.

Graphite. — The production of pure graphite was limited to Ticonderoga, N.Y., and is reported as unchanged. The total production of pure material was 400,000 pounds, worth $33,000. Small amounts of less pure material for foundery facings, etc., were produced in North Carolina, and at Cranston, R.I.

Fluorspar. — The production limited to the neighborhood of

Roseclare, Ill., and Evansville, Ind., is reported at 6,000 tons, worth $30,000, an increase of 1,000 tons over 1887.

Infusorial Earth. — The product came principally from Maryland, and amounted to 2,500 short tons, worth, before shipment, $12,500.

Zircon. — During 1887 and 1888, 25 tons of zircon were mined, principally in Henderson County, N.C., and sold for $10,000 for the manufacture of incandescent gas-burners. About 4 tons of monazite, 1 ton of allanite, 600 pounds of samarskite, and $500 worth of yttrium minerals were produced for the same use. About 6 tons of monazite and 5 tons of cerite were also imported.

Mineral Waters. — Amount sold in 1888, 9,628,568 gallons, valued at $1,709,302. In 1887 the product was 8,259,609 gallons, worth $1,261,473.

Totals. — The total value of the minerals produced in 1888 was $591,659,931. It is recognized that this is the sum of the values of substances taken in various stages of manufacture, and hence not strictly comparable with each other; still it is the most valuable means for comparing the total products of different years. The result is an increase of nearly $50,000,000 beyond the value of the product in 1887. In that year nearly every mineral industry showed an increase, and hence an increased total was evident. But the fact that the increase was so very large was due to rather exceptional conditions in a few important industries, and it could not reasonably be expected that a similar combination of circumstances would result in even a larger total value for 1888. Nevertheless the unprecedented stimulus given to the production of copper by an artificial price increased the total value of that product nearly $13,000,000, or nearly enough to offset the decline in the total value of pig-iron. The other important factors in the increase were coal and the other fuels, which followed the increased quantity of metals. With the anticipated decline of copper to the normal demand, a decline in the total value of the product in 1889 will not be inconsistent with the natural development of our mineral resources.

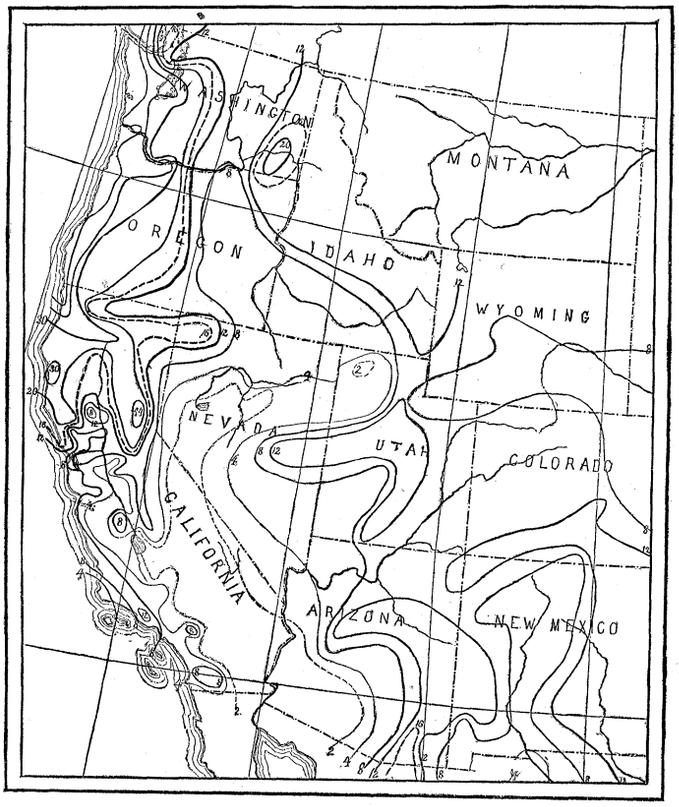
THE RAINFALL OF THE PACIFIC SLOPE.

GEN. A. W. GREELY, in compliance with the resolution of the Senate, dated Jan. 4, 1888, has compiled an interesting report on the maximum annual, minimum annual, and on the mean precipitation for each month of the year, for the Western States and Territories, the main part of which is a series of charts. The record from which these charts have been compiled aggregates 4,800 years for 661 stations, thus giving an average of seven years and three months to each station. The separate records, however, vary from two to forty years in length. The principal object of the report is to clear up the important question of the extent of the arid lands. Regarding this point, the chief signal officer says, —

"One great result which must redound to the benefit of the trans-Mississippi and trans-Missouri country by the publication of these official data will be the dispelling of erroneous and injurious impressions which have long prevailed regarding this region. In the early part of this century this territory was viewed as hardly suited for civilized man; its enormous plains and vast mountains being represented as arid and desert regions, unsuited for cultivation, and in many places even unfit for pasturage. Adventure, exploration, and circumstance have pushed the frontier westward, until the myths of the Great American Desert to the north, and of the rainless 'staked plains' to the south, have practically disappeared. It is none the less true, however, that the latest and most reliable text-book of meteorology of this country speaks of the areas between the Sierra Nevada and the Rocky Mountains, including portions of Utah, New Mexico, and California, as a region which is almost entirely destitute of rain, and that farther on the east side of the Rocky Mountains the country is a barren desert, almost without rain.

"As to the value of these charts, there should exist no reasonable doubt, since they not only show prospective settlers in these States and Territories the probable rainfall conditions, but likewise show it to parties contemplating industrial, agricultural, stock, and other investments in these extensive regions. It is evident to all, however, that the rainfall conditions for separate years vary quite considerably; and, indeed, the opinion has been put forth that these variations are not only enormous, but are so irregular as to render their prediction impracticable, and even that rain does not fall for years in certain sections.

"An examination of the charts of maximum annual rainfall and minimum annual rainfall of these regions shows clearly that rainfall conditions are considerably more equable than has been generally believed; so that the isohyetal lines are quite as regular on these charts of maxima and minima conditions as on those of average conditions. The minimum rainfall has never reached zero for any year, and annual or seasonal rainfalls less than one inch have occurred in south-western California and south-western Arizona at few stations only. These maps of maxima and minima precipitation must be of great practical value as showing the settler or investor exactly the extreme conditions which he must expect to experience in these regions. Another great value of the charts is the bringing to general attention and consideration very extensive areas of country in what has been known as the arid region, where late



LEAST ANNUAL RAINFALL ON THE PACIFIC SLOPE.

and careful observations have shown the rainfall to be far greater than has been usually attributed, and thus transfer these areas to the sub-humid districts.

"The great extent to which misapprehension as to the rainfall conditions of the arid regions has been corrected by these charts is evidenced by the fact that the area on which the mean annual rainfall is less than ten inches, shown on statistical maps of the 'Tenth Census' at 241,000 square miles, has been reduced to 126,000 square miles; while a similar reduction is shown in the area of country where the yearly rainfall is between ten and fifteen inches, which, given in the census chart at 385,000 square miles, is now limited to 259,000 square miles. In other words, the area over which less than fifteen inches of rain fall annually has been reduced almost a quarter of a million (241,000) square miles. A large area of country charted on the statistical map as having an average rainfall of less than five inches now entirely disappears in Texas, New Mexico, Utah, and Oregon, and is materially reduced in Nevada, Arizona, and California.

"Observations over a small, compact agricultural area of South Australia afford very reliable data as to the effect of rainfall upon annual wheat yields. It appears from these observations that