Microbes and Carpets.

In our endeavor to be comfortable in this vale of tears, there is a tendency to overlook the elementary laws of hygiene, and in no respect, perhaps, more so than in the superabundance of curtains and carpets—those non-patented contrivances for hindering the free circulation of fresh air and stultifying nature's automatic arrangements for the deodorization and disinfection of our homes. Carpets are always objectionable when they are not designed to permit of easy removal for cleansing purposes without the necessity of turning a room topsy-turvy. In most houses the carpet only comes up once a year, by which time it is as full of microbes and accumulated filth as its interstices will allow No wonder, then, if our rooms preserve a musty smell in spite of periodical opening of windows and vigorous sweepings, which only displace a portion of the dust to settle promptly elsewhere in some less accessible spot. Fixed carpets are even more objectionable and unwholesome in bedrooms, for there they absorb the fetid emanations of the night, and soak up various decomposable materials for future use. The ideal would be a polished wooden floor garnished with rugs in sufficient number to give an aspect and feeling of comfort, while admitting of easy exposure to the salutary influence of air and light. Rugs, carpets and curtains ought to be frequently shaken and hung up in the fresh air if they are to remain sweet, not once a month or year, but twice or thrice a week, if not oftener. At this price only can we hope to deprive confined spaces of their native unwholesomeness, and the sooner housewives lay this maxim to their hearts and act upon it, the better.—*Hospital Gazette.*

Union Label—Trade Mark.

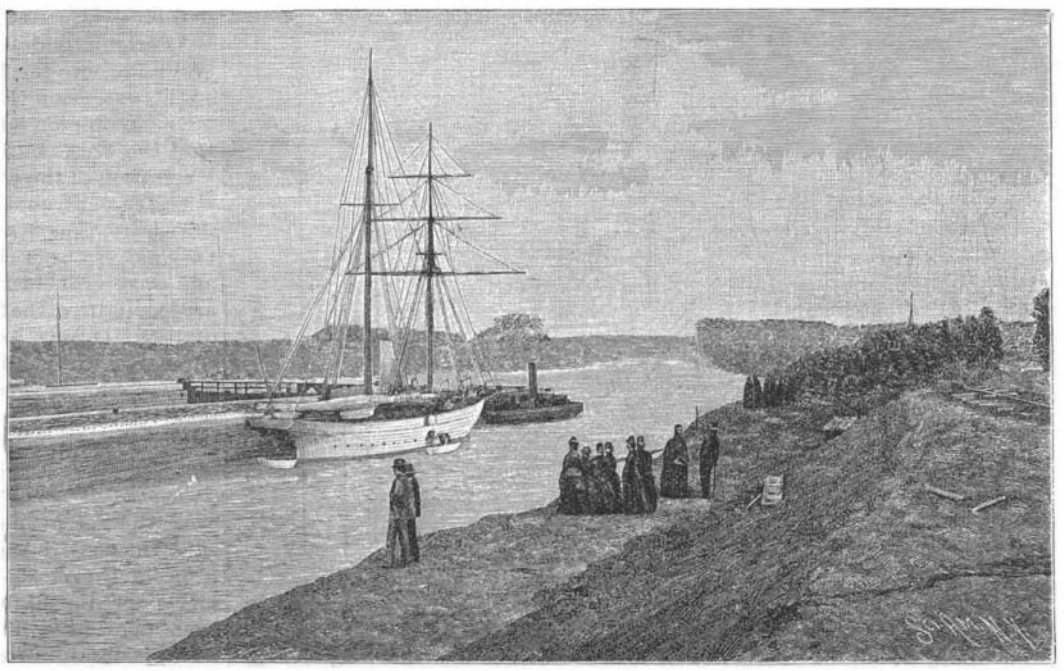
An interesting decision has just been rendered by the Supreme Court of Pennsylvania in a suit brought by Cigarmakers' International Union No. 126, of Ephrata, against one Brendle, to restrain him from using the Cigarmakers' International Union label on his goods. The defendant was a union manufacturer who had incurred the ill-will of local officials, and declined to use their labels, but issued similar labels or trade marks of his own. The union secured an injunction in the court below, but the Supreme Court reversed the decision of the court below on the ground that the Cigarmakers' Union, formed for the mental, moral, and physical welfare of its members, was a personal and social organization, not a commercial one, and, therefore, could not own a trade mark under the laws of Congress. It appears that the union label described the cigars it accompanied as being made by first class workmen, stigmatized all cigars not having the label as of inferior workmanship, and recommended the union cigars to all smokers throughout the world. In its decision the court said: "This is an attempt to use the public as a means of coercion in order to find a market for their goods or labor. A first-class workman is one who does first-class work, whether his name is on the rolls of any given society or not. Filthiness and criminality of character depend on conduct, not on membership of the union. Legitimate competition rests on superiority of workmanship and business methods, not on the use of vulgar epithets and personal denunciation. The International Union in this case has an avowed purpose to do harm to non-union men, to prevent the sale of their work, to cover them with opprobrium, and they ask a court of equity to say they have a right to do so. We decline to say so."—*Bradstreet's.*

THE finest stationary engines made in the world, for economy, durability, and elegance in design, are made in the United States. English engines are often bulky and clumsy. French engines are frequently erratic in design and fragile in construction.

THE MANCHESTER SHIP CANAL.

This great engineering work is now rapidly approaching completion, and will soon be in full operation. The first completed section, from the entrance at Eastham on the river Mersey to Weston, was opened for traffic on the 29th of September. The length of this completed portion is eleven miles, being almost one-third of the entire length of the work.

The first consulting engineer was appointed (to look into the project and report) in the summer of 1882. It was only in August, 1885, after making three trials, that the sanction of Parliament was obtained for building the canal. Before a single sod was turned in the great work, $1,750,000 was spent in forwarding and contesting the canal project.. In July, 1886, the contract for building the entire canal was let to Mr. Thomas Walker for $28,750,000. The allowed time for finishing the work was four years, with a large bonus for whatever time was gained in finishing.



THE MANCHESTER SHIP CANAL—VIEW FROM LOCKS LOOKING ALONG THE CANAL.

The canal extends from Eastham Locks on the south bank of the estuary of the Mersey River to Manchester, having a total length of a little over 35 miles. The minimum width on the bottom is to be 120 feet. The depth throughout is to be 26 feet. This is a very large cross section when compared with existing canals, which are as follows:

Ghent canal, 55 feet 6 inches wide on the bottom, 21 feet 2 inches deep.

Suez canal, 72 feet wide on bottom, 26 feet deep.

Amsterdam, 88 feet 7 inches wide on bottom, 23 feet deep.

Quite satisfactory progress has been made on the entire work, but the sudden death of Mr. Walker, the energetic contractor, proved rather embarrassing.

Mr. E. Leader Williams is the chief engineer of the work and has been one of its principal promoters from the beginning.

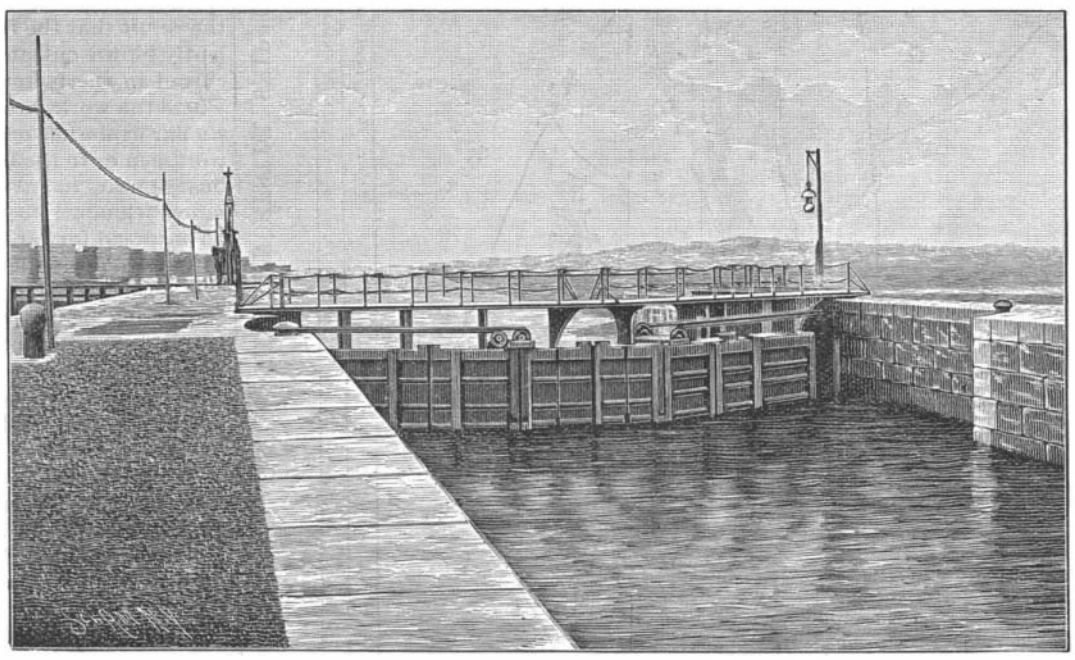
The canal is 48 feet wider than the bottom of the Suez canal, while the depth is equal; so that the largest cargo steamers can pass each other in the Manchester ship canal. At several points, near the locks and near the docks, this canal is wide enough for such ships to turn. For a length of three miles and a half, approaching Manchester, the width at the bottom is 170 feet, so that ships can lie outside the docks along the wharves on the Salford side. There will also be open side basins, or widenings at ship building yards, or where cargoes are discharged or loaded, for manufacturing establishments or storehouses adjoining the canal.

Five sets of locks—at Eastham, on the Mersey sea estuary; at Latchford, on the Mersey, above Warrington; at Irlam, above the junction of the river Irwell with the Mersey; at Barton, on the Irwell; and at Manchester—raise the level of the canal, on the whole, 60 feet above the sea. Of its entire length, twenty-three miles, inland from Runcorn to Manchester, will have been formed by cutting a straight and deep channel for the rivers Mersey and Irwell. The lower section, from Eastham to Runcorn, forms a curved line of twelve miles along the Cheshire shore of the broad inner expanse of the Mersey estuary; but at Weston Point, meeting the estuary of the navigable river Weaver, which is connected with an extensive system of canals, it will obtain valuable local traffic, especially the shipment of salt. A large trade with Cheshire and the Staffordshire potteries, by the Bridgewater canal, will also reach the ship canal at Runcorn, as well as that of the chemical manufacturers at Widnes. The Shropshire Union canals will feed the traffic at Ellesmere Port, near Eastham.

The Manchester docks, formed on both banks of the Irwell, chiefly in Salford, but also in Manchester on the site of the Pomona Gardens, Cornbrook, and extending to Throstlenest and the Albert Bridge, near the Old Trafford Road, will afford ample accommodation to the trade of that city. They occupy a space of two hundred acres. The water area of the dock basins is sixty-two acres and a half, and the quay frontages are three miles and a half in aggregate length, to which may be added a mile of open wharves along the wide part of the canal just below; and there will be two miles and a half of the canal bank, lower down, available for discharging cargoes into barges and lighters, and putting them ashore. Fifty hydraulic cranes, some of great power, will be provided at the Manchester and Salford docks.

The docks at Warrington, twenty-two acres and a half in extent, will have a railroad connection with the London and North-western and the Great Western Railway, which will bring a large coal and general traffic.

At Runcorn, at the head of the Mersey estuary, the docks belonging to the Bridgewater Canal Navigation, having been purchased by the Manchester ship canal, will always be accessible, instead of being entered only at spring tides as hitherto; the local trade advantages here, as well as those of the docks at Weston Point, for the Weaver navigation, have already been noticed.

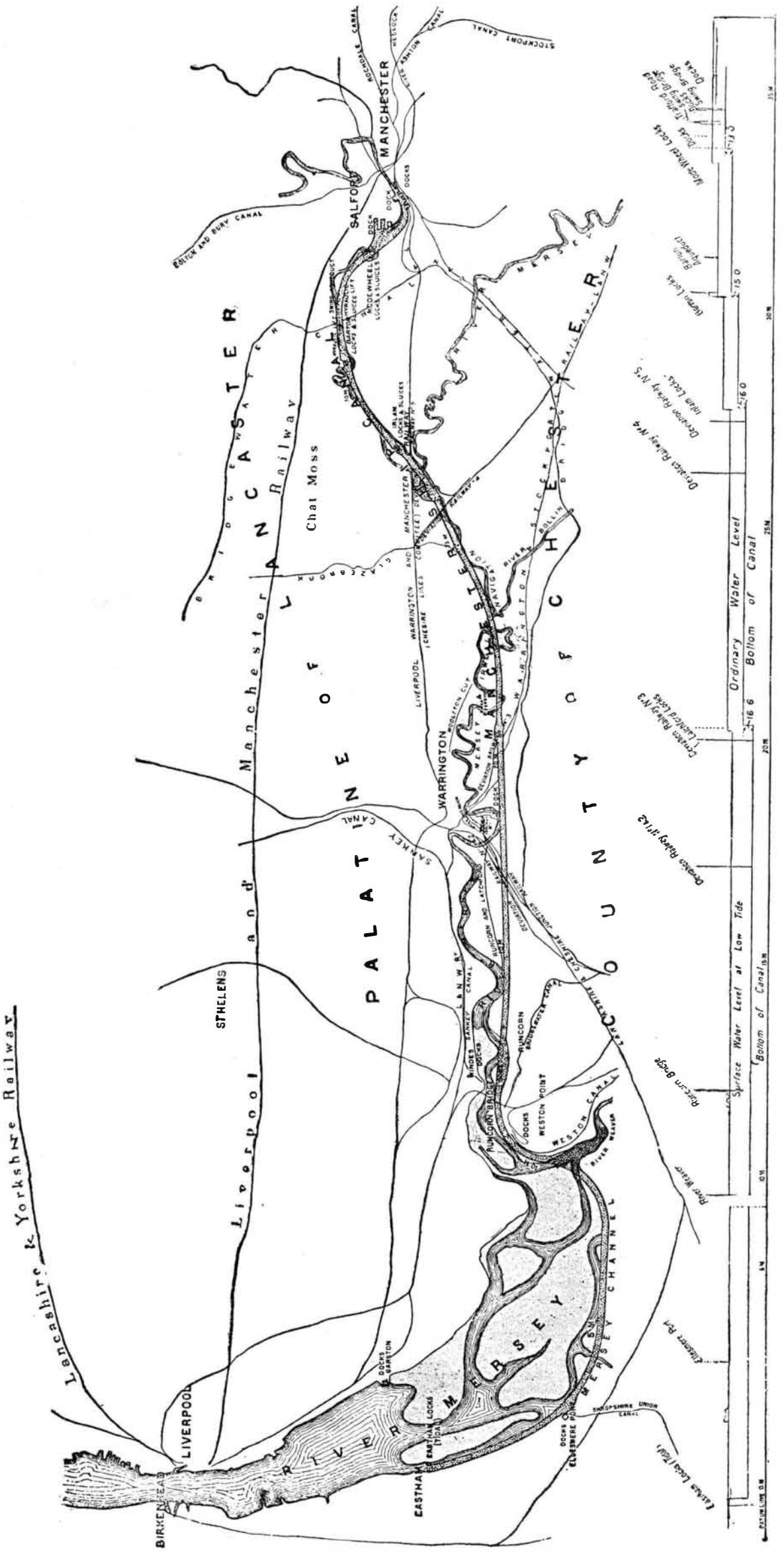


THE MANCHESTER SHIP CANAL—VIEW OF ONE OF THE LOCK GATES.

The ship canal will be entered from the sea, or rather from the Mersey estuary, about four miles above Birkenhead, by the tidal locks at Eastham, all the gates of which will be open at high tides. The sills of these entrances will be 11 feet lower than the deepest dock sills at Liverpool or Birkenhead; and the channel approaching them will be dredged 3 feet deeper than the lock sills.

One of the great causes of expense has been the erection or reconstruction of railway bridges crossing the canal, each at a high elevation, to give a clear headway of 75 ft. above the water, and with the approach lines of railway to rise by moderate gradients on each side. The Cheshire Lines Railway at Irlam, the Wigan Junction line, the Warrington and Stockport line, the Grand Junction line at Warrington, and the London and North-Western Railway at Runcorn, must be treated with such costly alterations. The Barton aqueduct of the Bridgewater canal across the Mersey is replaced by an opening swing bridge, which is an iron trough, closed at each end when the bridge is opened, to contain the water of the Bridgewater canal, held thus safely above the level of the ship canal.

There will be hydraulic lifts by which laden barges can easily be transferred from the one canal to the other. The locks on the ship canal are not single, but each set of locks has receptacles of different sizes for vessels of different classes, to avoid the waste of water in using a lock much larger than the size of the vessel



THE MANCHESTER SHIP CANAL—LONGITUDINAL SECTION FROM EASTHAM TO MANCHESTER.

requires. The canal level descends 16 ft. at the Trafford locks, near Manchester, 14 ft. at the Barton locks, 14 ft. at the Irlam locks, again at Latchford, 16 ft. more, and finally at Eastham, to the level of the sea. The largest lock at Eastham is 600 feet long and 80 feet wide.

The line of the canal is cut through flat country, marsh meadows chiefly, pretty straight beyond the junction of the Irwell and Mersey, avoiding the many windings of those rivers, which are generally turned into a new artificial channel, somewhat to the south of the old left bank of each river. In a few places only, on the Mersey, where the ground is higher, the cuttings are 50 ft. deep, partly through sandstone, which has been utilized for the construction of walls, and here the sides of the canal, being of rock, are made more perpendicular than in the softer ground. The whole quantity of earth and stone to be excavated has been computed at forty-eight millions of cubic yards, which is more than the quantity of excavation required for the Panama ship canal, including the Culebra hill cutting; but the undertaking of M. De Lesseps had other difficulties to contend with, in the dam of the river Chagres. Mr. Walker, the contractor for the Manchester ship canal, set to work as large a number of men, not negroes, but English "navvies," with more numerous and powerful machines, and with about one-tenth the expenditure of money. It is stated that nearly 15,000 hands were at one time employed, with eighty steam excavators of four different kinds, pumping engines, steam cranes, and 150 locomotives, for which 200 miles of railway were laid down to remove the earth.

We give herewith a map of the Manchester canal and illustrations of some of the locks.

As originally designed, the canal was to extend several miles into the Mersey, and it was upon the effect of this extension that Mr. James B. Eads, of St. Louis, gave an opinion which was conclusive to Parliament that the works built as designed would lead to the deterioration of the channel over the bar at Liverpool. His argument on this subject, with the illustrations drawn from maps and notes, some of which were a century old, is one of the best engineering papers extant, and was so conclusive to the minds of the Parliamentary committee that the plan was thrown out immediately. It was for this, on which he spent about three weeks' time, he received probably the largest professional fee ever received by an American engineer, at least, for an equal time spent on any subject, namely, nearly $17,000.

Improved Iron Process.

At the recent meeting of the Iron and Steel Institute, the contribution of Mr. Massenez was in many respects the most valuable. Manganiferous molten pig, poor in sulphur, is added to sulphureted pig iron, poor in manganese; the result being that the metal is desulphurized, and a manganese sulphide slag is formed. The mixer in which the process is carried on is a large vessel, in appearance, to judge by the drawings shown, like a converter. The apparatus in use at Hoerde will hold seventy tons of molten pig, but it has been shown that a vessel of about twice the size would be advisable. Details of the working are given by the author, and will be of great use to steelmakers working with phosphoric pig. In the discussion which followed several speakers bore testimony to the value of the invention, Sir Lowthian Bell intimating that a saving of 2s. 4d. per ton could be made by this method over the process of remelting pig in the cupola—a step which has to be taken when it is desirable to combine the product of different blast furnaces. In the large mixer, metal from two or more furnaces can be brought together.

Explosions of Coal Dust.

Two accidents due to the explosion of coal dust are described in the *Jahresbericht d. k. preuss. Gewerberathe fur* 1888. At the Reichenwald works an explosion of coal dust took place in the dried coal store room while the operations were in full progress, with the result that the front of the drying house was violently blown out and a considerable conflagration occurred in the factory. At Furstenberg on the Oder, where the works are entirely built of stone and iron, a similar explosion occasioned no damage, either to the workmen or to the buildings. The ignition of the coal dust appears to have commenced in the lowest feeding screw belonging to the drying room elevator, and to have spread forward to the store room and backward to the two drying houses. Five explosions followed in quick succession in different parts of the works, the detonation being strongest in the store room, and in a few minutes all the chambers containing dry coal dust were on fire.

These accidents afford further proof of the well-known fact that coal dust is itself a dangerous explosive, the presence of which must be guarded against in factories, mines, etc., by thorough ventilation and other protective measures.

The American Newspaper Annual for 1891.

This splendid volume, issued by N. W. Ayer & Son, Philadelphia, contains a descriptive list of the newspaper press, a gazetteer of the places in which papers are published, and a guide to the intelligent placing of general and special advertising. It contains nearly 1,400 pages, but there is no waste room between its covers, every page has its purpose and is full of solid, useful matter.

The total number of newspapers and periodicals enumerated, located, and described in this edition is 19,011, an increase over last year of 480. The average net growth in legitimate newspapers and magazines for the last three or four years has been from seven to eight hundred; and excepting in a few localities, there has been no great variation from this average this year.

The price of the annual is $5. It represents a vast amount of laborious research, and is of unequaled value to all who are in need of an accurate and reliable compendium of the American press.

Geological Notes—Crystalline Rocks of Missouri.

We have received Bulletin No. 5 of the Geological Survey of Missouri. Besides a paper on the clays and building stones tributary to Kansas City, by G. E. Ladd, resident geologist, it also contains an extremely interesting and valuable paper on "The Age and Origin of the Crystalline Rocks of Missouri," by Erasmus Haworth. The following prefatory remarks to this paper are by Arthur Winslow, State Geologist:

"The crystalline rocks of Missouri occur exclusively in the southeastern portion of the State. They are abundantly exposed in Madison, Iron, and St. Francois Counties; but they are also found, though less frequently, in at least eight other counties of this section of the State. They constitute the mass of the rugged hills and mountains of Iron and Madison Counties, and elsewhere their characteristic occurrence is in similar hills surrounded by limestone valleys. These are truly ancient elevations, older than any others in the State, older than the mountains of Arkansas, older than the Appalachians, older than the Rocky Mountains. If venerable be an attribute of great age, they certainly merit that appellation. And not only are all other rocks of Missouri youthful as compared with these, but there is a genetic relationship, and the former are in a sense descendants of the latter. For, when the limestone and other sedimentary rocks were yet unformed, these crystalline rocks must have existed as parts of a continental mass, and from the degradation of this continent resulted the materials of the later formed sedimentary rocks. The present granite and porphyry hills are but protruding parts of the remnant of this ancient continent which stood as islands above the ocean waters while the beds of limestone and sandstone were being formed around them; which rose with these beds when they were lifted from the waters; which now, rugged and weather-beaten, yet tempered by age and varied experience, rear themselves above the surrounding younger rocks and bid fair still to live when the latter have yielded to the forces of degradation.

"The question of the origin of these rocks has, heretofore, never been made a subject of such exact study as modern methods call for and as its importance justifies. Swallow,* while recognizing the granites and the porphyries as igneous rocks, presents little or no demonstration in support of this view, and, further, he classes, as metamorphosed slates and conglomerates, rocks which the present work shows cannot be separated from the porphyries. Other writers seem to have substantially accepted this conclusion in a large part, but Pumpelly† expands upon it and applies the hypothesis of metamorphosis to all of the Missouri porphyries.

"Mr. Haworth's study of these rocks began in the summer of 1886, and he has ever since pursued the subject with zealous yet patient enthusiasm. This he has done partly at his own instance, partly in the interests of the National or State Geological Surveys, but always without pecuniary gain. Hence this survey, though fortunate in gleaning the results of his years of study, is also under obligations to him for this contribution.

"The association of iron ores with these rocks brings the question of the origin of the latter into direct economic importance; for the distribution of these ores is fundamentally dependent upon this question. Exploration for, or development of, such ore bodies based upon wrong theory must invariably lead to profitless expenditure."

Rare Salts.

At a recent meeting of the Chemical Section of the Franklin Institute, Mr. Waldron Shapleigh exhibited the following specimens of salts of the rare earths:

Praseodymium, neodymium and lanthanum oxides, sulphates, nitrates, chlorides, carbonates, oxalates, acetates and double salts with the alkaline metals.

Cerium oxide, oxalate, chloride, nitrate, and the double nitrate of the cerous and ceric oxides with ammonium.

Yttrium and erbium nitrates, oxides and oxalates.

Zirconium oxide, nitrate, sulphate and some double salts.

Yttrium and erbium (not separated) oxides and nitrates obtained from gadolinite, cerite, monazite, fergusonite and samarskite. Thorium and vanadium salts.

Also large specimens of the following minerals from which these salts were obtained: Samarskite, zircon crystals and monazite sand from North Carolina, monazite sand from Brazil, gadolinite from Texas and allanite from Virginia.

Mr. Shapleigh said the collection was of interest, as it is the first time the salts of praseodymium and neodymium have been shown, and probably separated in this country. Some of the salts have not been heretofore prepared.

The separation of these elements is long and tedious; the specimens shown have undergone nearly 400 fractional crystallizations, and have been in a state of constant preparation since early in 1888. Tons of cerite and monazite sand have been used, and tons of the salts of cerium and lanthanum obtained, but the yield of praseodymium oxide has been only a few kilos. The percentage of neodymium is much higher.

Dr. Carl Auer von Welsbach, in 1885, was the first to separate didymium into these elements, and, together with Professor Bunsen, to determine their atomic weights, that of Pr 143·6 and of Nd 140·8. The oxides are M_2O_3 and probably M_4O_7.

With one exception, the salts of praseodymium exhibited were of a pale green, and of neodymium pink or amethystine color.

Zirconium, lanthanum and cerium should no longer be classed among rare earths, as hundreds of tons of ores from which they are obtained have been located in North Carolina, and there seems no end to the deposits of monazite sand, one of the richest ores, and containing most of the rare earths. In Brazil it does not have to be mined, as it is in the form of river sand. In North Carolina it is found in washing for gold.

Should the arts, trades, or manufactures create a demand for these so-called rare earths, nature could readily supply it from these two localities.

Thorium and yttrium minerals are not so easy to obtain; they have, however, recently been found in quantity in North Carolina and Texas.

Working on a commercial scale, he finds the yield of lanthanum from cerite nearly one per cent higher than stated in the analyses published.

The Loss of Old Age.

The type of essay *De Senectute*, of which Cicero gave us the model, is not much affected now. Perhaps the Roman orator exhausted the sentimental and philosophic side of the subject. At any rate, the view of old age which most interests moderns is not how to enjoy it, but how to get and prolong it. Perhaps this is really the essential thing, since it appears as if, despite sanitation and all our modern improvements in living, old age is gradually slipping away from us.

It is true that we have immensely lessened infant mortality and extended the mean duration of life to over forty-five years. But the average number of old people is not correspondingly increased, and it is even charged that when great old age is now reached, it is abnormal and the evidence of a deep-seated neurosis whose penalties are visited on succeeding generations.

The foregoing statements are not vague generalizations, but based upon carefully collected vital statistics. Sir James Crichton Brown, in a recent address on old age, states that since 1859, in Great Britain, the decline in the death rate has been 17·5 per cent at all ages under fifty-five, and only 2·7 at all ages above fifty-five. Between the years sixty-five and seventy-five there has actually been an increase in the death rate.

The cause of this increment in later death rates is attributed to cancer, heart diseases, nervous diseases, and kidney diseases.

These diseases are mainly of the degenerative class, and due to the wear and tear of modern life. This is shown by the fact that the death rates after forty-five are less among women and less in the country than in the city.

Dr. Brown gives us the further discomforting reflection that men and women are growing old before their time. "Old age," he says, "is encroaching on the strength of manhood, and the infirmities associated with it are stealthily taking possession of the system some years earlier than they were wont to do in former generations. Deaths due simply to old age are now reported between forty-five and fifty-five years of age, and in large numbers between fifty-five and sixty, and there has been a reduction in the age at which atrophy and debility—another name for second childishness—kill those who have passed middle life. Presbyopia, or the long-sightedness of old age, in which near objects cannot be distinctly seen unless held at a considerable distance from the eye, is believed by some experienced ophthalmologists to begin, as a rule, rather earlier than it used to do. No trustworthy statistics on the subject exist, and of course general impressions ought to be received with caution, for it must be difficult to distinguish how far the early recognition of ocular failure in these days is attributable to the increased care bestowed on the eye, and how far it should be ascribed to untimely invasion, but I certainly attach great weight to the opinion of Mr. Critchett, who says, 'My own experience, now extending over a quarter of a century, leads me to think that both men and women now seek aid from glasses at an earlier period of life than their ancestors.' Very significant also is the statement of Mr. Brailey that 'people who have lived long in hot climates like India become presbyopic four or five years earlier than they would otherwise have done,' for life in a hot climate really means excessive wear and tear to a European. The ordinary age for the adoption of spectacles for reading used to be fifty; it is now, I believe, nearer forty-five."

The teeth are dropping out earlier, baldness is more prevalent, senile insanity is more common, and appears sooner than it used to do; suicide is increasing, and most suicides occur between the age of forty-five and sixty-five.

This is rather a doleful outlook, and one naturally seeks to know if Dr. Brown has a remedy for the ills he portrays. "There is," he tells us, "no short cut to longevity. To win it is the work of a lifetime, and the promotion of it is a branch of public medicine. Perhaps one of these days we may have an International Congress on Old Age, with an exhibition of dotards for warning, and of hale and hearty centenarians for encouragement. At any rate you may rest assured that it is by steady obedience to the laws of health that old age may be attained, and by judicious regimen that it may be prolonged."

This is all very true, but, unhappily, it has been well known since the days of Hufeland. Perhaps the best and only thing that we can do is to teach children more earnestly the fact that to enjoy the last half of life they must take care of the first half. The maxim, "*Dum vivimus, vivamus*," is the one which above all makes old age a sickly and unhappy one.—*Med. Record.*

Increasing Locomotive Cylinder Power at Speed.

The Sturtevant Blower Manufacturing Company, of Boston, describes many experiments relating to the resistance to the flow of air through pipes at a high velocity. These experiments show that a single opening of a given area is vastly more effective to conduct steam or air than the same area divided into small separate apertures. It is evident that a long, thin opening will not carry the same amount of steam that a wider and shorter opening will when of the same area; or if two openings have the same area, the one which has the width and length more nearly the same will carry the larger amount of steam in a given time and at a given pressure.

As locomotives are now built, only a fraction of the total weight is utilized at speeds above forty miles per hour. Hence an increased weight is not necessary to pull heavy trains at high speeds after they have attained speed; also there is sufficient steam capacity in the ordinary locomotive to furnish the steam required to do heavy express work. The only means we have, then, of increasing the power of express locomotives at speed is to increase the mean effective pressure in the cylinders. To do this there is no surer way than to increase the outside lap and the travel of the valve; but it must be acknowledged that an increase in the length of the port has some good effect on the admission line, and there is no good reason why the admission should not be made more perfect by the use of the Allen auxiliary port, provided it is made wide enough through the body of the valve.—*Railroad Gazette.*

The Hoop Snake.

The Pittsburg *Leader* reports the following as having taken place at New Castle, Pa., October 21: Hon. Henry Edwards, ex-member of the Legislature, who resides at Moravia, this county, has received a severe shock from fright. C. H. Weekly and L. P. Little were building a fence near Mr. Edwards' home, when they were surprised to see the ex-member of the Legislature run down the road minus hat, coat, and vest, and loudly calling for help. He was pursued by a mammoth hoop snake, which was running, or rather rolling, after him. The reptile had its tail in its mouth, and was rolling along hoop fashion. Little and Weekly succeeded in killing it. The snake measured exactly five feet nine inches in length, but its body was not much thicker than a man's finger. Near the end of the tail was a horn-like affair, which is said to be the reptile's means of defense. This horn was one and one-fourth inches in length, and its sting is certain death. The snake has been preserved in alcohol.

In the SCIENTIFIC AMERICAN for November 30, 1889, we gave an engraving and an interesting description of the hoop or milk snake, by our valued contributor, Dr. Nicolas Pike. It will be seen from the information there given that the alleged rolling of the hoop snake is an optical illusion. The reptile does not roll and does not take its tail in its mouth. It progresses by loop movements, somewhat like the measuring worm. The snake gathers itself up into large loops, and pushes itself forward, all with such amazing rapidity as to appear, to a frightened beholder, as if it actually rolled. The mind of man is very easily deceived by false impressions made through the eye. There are other reptiles besides the milk snake that progress by the loop movement, for instance, the bull or pine snake, and also the queen snake.

A Useful Plaster.

A plaster composed of one part of carbonate of lead in two parts of olive oil is considered in Holland to be an efficacious remedy for sprained joints. Dr. Duhamel has been trying its effect in Paris on a number of cases, most of which were sprains of the ankle, and it is said the patients were made to walk as soon as the plaster and retaining dressings had been applied.

*Second Annual Report. By G. C. Swallow, State Geologist, 1854, pp. 133 to 135.

†Report on the Iron Ores and Coal Fields of Missouri. By Raphael Pumpelly, State Geologist, 1873; pp. 3 to 28.