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THE LATEST DISCOVERIES IN THE NATURE OF THE SUN.

Frankland has recently made the important discovery that when a flame of hydrogen gas burns in oxygen under high pressure, it becomes very luminous, and gives in the spectroscop a continuous spectrum without lines, the same as is the case with incandescent solid or fluid bodies. This induced Mueller to examine with the spectroscop the electric spark when it passes, not through highly rarefied, but through condensed, gases. He found that the hydrogen spectrum becomes continuous when the gas is highly condensed in the tube, and when it is raised to a very high temperature by means of the spark of a Rhumkorff coil, intensified by the use of a Leyden jar.

If the spark, which this apparatus produces with the Leyden jar, is passed through a tube in which the hydrogen gas is highly rarefied, the three characteristic narrow lines, the red, blue and violet, show themselves well defined; when the rarefaction is diminished so as to obtain a density equivalent to the mercurial pressure of one inch, the blue and violet lines become broader, while the space between D and F becomes feebly luminous. The rest of the spectrum remains, however, like a dark background.

By increasing the pressure of the gas, the two lines mentioned expand more and more, so that at last they appear as a luminous ground; at the same time the red line begins, at a pressure of 14 inches of the mercurial column to appear as a broad red band, which is no longer separated by a dark space from the continuous orange color of the background; but the space between is luminous.

At higher pressures, the luminosity of the continuous spectrum increases everywhere, so that, at a pressure of 40 inches, it is all illuminated between the extreme hydrogen lines, like a spectrum of a white hot solid body; but the light is somewhat differently distributed. At 60 inches mercurial pressure, the whole spectrum becomes indeed dazzling, and then the following curious and interesting phenomenon appears: The inside of the glass tube begins to volatilize and shows the line of the sodium vapor as a beautiful double dark line. It is thus seen that, for the production of the dark lines of Fraunhofer, the light of a glowing solid or liquid body is not indispensable.

In consequence of all this, Zoellner comes to the conclusion that the visible solar surface is formed by that layer of its hydrogen atmosphere in which, by increased pressure, the spectrum has become continuous; and that the glowing fluid surface of the solar globe lays below this bright luminous envelope of hydrogen. If we now consider the sun spots as local, slag-like, cooling products, floating on the glowing liquid surface and the penumbra as condensation clouds which surround the shores of the slag islands to a certain height, then the centers of the sun spots must necessarily appear deeper than the visible solar surface, and the phenomenon so minutely observed and described by Wilson is explained in the most natural manner. The depth of the dark solar spots below the luminous surface has been determined, by different observations, to be on an average about 8 seconds of a degree; as this is nearly the 225th part of the apparent solar diameter of 30 minutes, it is also the 225th part of the 800,000 miles of the actual solar diameter, which gives nearly 2,600 miles for the depth, which thus is about equal to the diameter of our moon.

Among the characteristic forms of the protuberances, there are many which compel the observer to the conclusion that enormous and powerful eruptions of glowing hydrogen are taking place. Zoellner has often seen such protuberances project to a height of 3 minutes of a degree, the tenth part of the solar diameter, 80,000 miles high in the time of 10 min-

utes. The enormous masses of hydrogen thus suddenly let loose into space, originate, according to this observer, in local accumulations, which form under the liquid surface, and which at last, by their increasing tension, break through the latter in the way that volcanic eruptions break through the solid earth's crust.

On the theory of the conservation of forces, Zoellner has calculated the temperature equivalent to the eruption of such a mass (as is observed in the protuberances), with the velocity and the distances measured. Without going into the mathematical details of his calculation, we will only communicate the results. They are that the temperature of the condensed gas under the liquid crust is 80,000° Fah. higher than the temperature of the solar surface above the crust. Further, it is easy to find that the velocity of the masses escaping, in 10 minutes to a height of 80,000 miles, is 133 miles per second, a velocity 20 times greater than that required, on our earth's surface, to be imparted to a body in order to cause it never to return when thrown upward.

Basing his speculation on the mechanical theory of heat, Zoellner finds the mean temperature of the solar surface to be 40,000° Fah., which is so high that iron must exist in the solar atmosphere as gas, and all chemical affinities between different substances must be totally suspended, which, in modern science, is called the condition of dissociation.

The temperature of the inner mass of the sun is therefore about 120,000° Fah.

Zoellner further calculates that, as the pressure on those places where the hydrogen spectrum begins to be continuous is about one quarter of the atmospheric pressure, the pressure of the solar atmosphere on the whole area of its liquid surface must be 134,000 terrestrial atmospheres. But on the inner space whence the protuberances escape, the pressure is 4,070,000 atmospheres; which is so enormous a pressure that, notwithstanding the high temperature prevalent there, the permanent gases, even hydrogen, can exist in a fluid condition alone.

This view of the solar constitution is the only one which agrees with the actual density or specific gravity of the mass of the sun, as determined by astronomy.

A WORKING MAN'S CITY.

An English paper states that on August 3, the first stone of a workman's city was laid with appropriate ceremonies at Wandsworth, England. This city, laid out in lots for 1,200 dwellings, is situated on the Shaftesbury Park estate, and is to be built by the Artisans', Laborers', and General Dwellings Company, established in 1867. The object of the association is particularly to enable workmen to become owners of their dwellings in the course of a stated number of years, by the payment of a small additional rent. The Shaftesbury Park estate contains about forty acres, and is situated near London, on the line of the railroad to Dover, by which road facilities for traveling to and from the metropolis will be afforded. The houses are to be thoroughly drained, and economically but substantially built. Ample school accommodations are to be provided, and a hall for lectures and public meetings is to be built. A coöperative store is to be established, and public houses are to be prohibited. The well known philanthropist, the Earl of Shaftesbury, has taken a great interest in this enterprise, and laid the first stone of the buildings.

We regard the above as an excellent movement, and we wish that something of the kind, on a still larger scale, might be inaugurated here, for the benefit of the poorer class of working men in this city. Their domestic situation is indeed deplorable. Living daily from hand to mouth, their earnings are absorbed by the payment of high prices for poor food, bad clothing and wretched apartments. The very first requisite for their improvement is the provision of good homes, — which they will never provide for themselves. Somebody must do it for them.

The good and the charitable, those who are blessed with a superabundance of this world's luxuries, others who have time to spare and willing hearts to help, might, we think, unite under one effective organization, having for its especial object the erection of suburban cottages, for the purpose here indicated.

It would be practicable for such a society to obtain charitable contributions for the purchase of lands on some of the steamboat or railway lines, accessible to New York, to grade, drain, and erect hundreds of cottages, to be let to working people, under proper sanitary regulations, at rentals merely equivalent to the cost of repairs or maintenance. School houses, reading rooms, and other needful appliances would of course be included in the plan. The operations of such a society might even be extended to the supply of the tenants with food, clothing and fuel at wholesale prices.

NEW CANAL THROUGH FLORIDA.

By authority of the Assembly of the State of Florida, a corporation has been formed with a capital of nine hundred dollars, to be increased to twenty millions of dollars if necessary, for the purpose of constructing a canal and improving the navigation of certain rivers, thus forming a new route for the shipment of goods, by water, from the Atlantic to the Gulf of Mexico. The canal will extend from the St. John's river, through Lake Kerr and the Ocklawaha river to Silver Spring, which is the summit, and where an abundant supply of water exists, thence westerly twenty-four miles to Blue Spring, thence nine miles to Fort Clinch on the Withlacoochee, and down this river, nine miles, to the Gulf. Total, fifty-two miles. It is stated that any required depth of water can be obtained, the lockage will be small, and the expense of construction very moderate. Silver Spring and

Blue Spring are the outlets of two subterranean rivers and their supply of water is very constant. Silver Spring is stated to yield a flow of 628,320 cubic feet per minute, which is more than sufficient to supply a canal large enough to accommodate ocean steamers of the largest size.

SCIENCE IN COURT.

A trial for murder has lately been concluded at Carlisle, Pa., during which some very remarkable incidents, connected with the scientific attainments of the witnesses, were developed. The prisoner, Paul Schoeppe, M.D., an intelligent, highly educated physician, thirty years of age, a graduate of the university of Berlin, had, in 1868, established himself in practice at Carlisle, where his father had previously settled, and was there the clergyman of the Lutheran Church.

Dr. Schoeppe soon acquired the confidence and esteem of the community, and among others made the acquaintance of a maiden lady, Miss Steinecke, seventy years of age. Mutual admiration resulted in an engagement of marriage; the lady made a will, bequeathing her fortune of fifty thousand dollars to the doctor. They were shortly to be married, intending to leave at once for Europe to avoid the annoyance of the gossips. But their plans were frustrated by the sudden death of the lady, who was taken ill and died within twenty-four hours, attended by Schoeppe and another physician named Herman. No suspicion of death from any other than natural causes appears to have been harbored by anybody until some time afterward, when the relatives of the deceased filed, for probate, an old will by which the property of the deceased was to come to them. Dr. Schoeppe now presented a more recent will, made in his favor by Miss Steinecke, and demanded the property. The relatives thereupon raised the cry of murder by poison against him. The newspapers hounded them on, his neighbors were filled with suspicion, and the unfortunate man was arrested, indicted, tried, found guilty and sentenced to be hung. This was in December, 1869. On this trial two experts, Dr. J. S. Conrad and Professor Wm. E. A. Aiken, both of the Baltimore Infirmary, were the chief witnesses against the Doctor, and they testified that they had made careful medical and chemical *post mortem* examinations of the body of the deceased, and found prussic acid present in the stomach, and were satisfied that death had resulted from the administration of that poison. Dr. Herman also testified that, in his opinion, the symptoms shown during the illness of the lady were those resulting from poison.

The criminating evidence, though satisfactory enough to the judge and jury, was considered worthless by intelligent scientific men, the Doctor protested his innocence, and the strongest efforts were made for his reprieve. But his townsmen were firmly prejudiced against him, and there was a popular clamor for his execution. Two days before the appointed time for the execution, however, the Doctor's friends succeeded in obtaining a reprieve from the Governor, and subsequently a new trial was ordered, which has just taken place, resulting in the triumphant acquittal of the prisoner. On this second trial the three original witnesses, Conrad, Aiken, and Herman, were again brought forward, but this time they were subjected to a straightforward cross examination, during which they were compelled to give to the Court the most particular details of their alleged *post mortem* examinations, and were closely questioned as to the state of their actual knowledge in regard to the nature and action of poisons upon the human system, the symptoms of its presence and the proper methods of its detection. It clearly appeared from these questionings that the three witnesses were, confessedly, a trio of ignoramuses, not posted in the sciences pertaining to their own professions, and unqualified to give to a jury any reliable information in regard to the subjects they were so solemnly called upon to testify.

For example, Dr. Conrad testified that he had made a careful *post mortem* examination of all the important organs of the body of the deceased, such as the brain, heart, liver, and stomach, which he pronounced healthy. But, on cross examination, he said that he had not examined any of these organs under the microscope.

He stated that he found the heart healthy, but he had not examined it under the microscope, and was not apparently aware of the important fact, testified to by Professor Wood for the defence, that it is impossible for the best pathologist to decide that the walls of the heart are healthy unless a microscopic examination is made. Granular degeneration has been found by means of the microscope to exist, when to the unassisted eye, the heart looked perfectly healthy. Professor Wood also showed that some of the most common causes of sudden death are to be found in the kidneys and spinal cord; but these organs Dr. Conrad had failed to examine.

In regard to the brain, Dr. Conrad had also failed to make any careful examination, because he did not notice how much blood ran out of it when it was opened, and therefore could not tell whether there had been any congestion.

It was shown for the defence, on the highest medical authorities, that almost any disease of the brain substance may be hidden, without causing any notable symptoms, and the subject be suddenly stricken down with stupor and unconsciousness, without convulsions, gradually deepening into death—which were the symptoms of the deceased. It was also shown that softening of the brain or change in the small vessels can only be ascertained with absolute certainty by microscopic examination, which had been wholly neglected by the witnesses for the prosecution.

The testimony of Professor Aiken for the prosecution, in reference to the finding of prussic acid in the stomach of the deceased, was a lamentable confession of his chemical ignorance and careless manipulation. On his direct examina-

tion he testified, positively, that he had found prussic acid actually present in the stomach of the deceased; but on being cross-questioned and required to give the details of such finding, he admitted that he did not actually extract any of the prussic acid at all; but what he did was to mix a solution of potash, sulphate of iron, and muriatic acid with some of the juices distilled from the stomach of the deceased; these solutions, he said, when mixed with anything containing prussic acid, give a blue color; and as he obtained this color, he was satisfied that prussic acid was present. "All I did," he swears, "was to satisfy myself that a blue color resulted, and that satisfied me that prussic acid was there." He then made a vapor test and got a red color, which confirmed his previous test, he thought; finally admitting that he obtained only the merest trace of color in both tests. The nitrate of silver test, which is admitted by intelligent chemists to be the best test of all for prussic acid, was not used by Aiken.

It was shown for the defence, by the testimony of Professor John J. Reese, LL.D., of the University of Pennsylvania, that the saliva, which would naturally flow into the stomach of the deceased, was capable of producing the same results that Aiken had alleged that he found, and it further appeared that the colors had probably been introduced into the liquids by Aiken himself, by careless manipulation, and did not result from the presence of prussic acid. Dr. Reese further showed that in a chemical analysis, in such a case, it is the duty of the chemist to be so thorough, so complete, so exhaustive, as to leave no test untried. He further showed that Aiken had completely failed in this, and pointed out his errors in the processes of distillation, in which all the recognized tests for the presence of prussic acid had been omitted. The most overwhelming medical evidence was also presented for the defence, showing that the prosecuting witnesses were not properly informed as to the symptoms produced by poisons upon the human system. Finally it was conclusively proven that the symptoms exhibited by the deceased were those occasioned by natural causes, namely, the contraction of the kidneys, resulting in the injection of uric acid into the blood, which produced serous apoplexy or congestion of the brain—of which the patient died. The evidence for the prosecution was completely broken down, and the prisoner was acquitted by the jury, and is now free.

The Chief Justice remarked that he considered the evidence against the Doctor so feeble that, had it been presented to him on the hearing for binding over to answer the charge, he could not see how he could have done so, further remarking that he "believed that it was God's providence which alone had saved the Court and former jury from committing a great wrong."

The Doctor has renewed his application for the probate of the will, and it is to be hoped he will receive the fifty thousand dollars bequeathed to him. It will be a poor recompense for the terrible ordeal through which he has passed, for the three long years of imprisonment that he has suffered, and for the loss of his business, reputation and property.

Some of our cotemporaries, we observe, in commenting upon the evidence in this singular case, express the opinion that scientific knowledge is, after all, of little practical value; for it appears that experts are always to be found who are ready to contradict each other in testifying upon a given statement of facts. But this, we think, is an erroneous deduction. An intelligent cross-examination will invariably demonstrate whether the expert is really a man of knowledge and science, or only an ignorant pretender. If the latter, his contradictions will have no weight, will perplex no intelligent mind. The importance and value of thorough scientific training, and its utility in the detection of professional fraud, ignorance, and humbuggery, has, in our opinion, seldom been more strikingly exhibited than on this remarkable trial.

THE FAIR OF THE AMERICAN INSTITUTE.

The same delay in forwarding and arranging goods for exhibition, which has rendered the first two weeks of all previous Fairs of the American Institute periods of disorder and confusion, seems to have been the case in the exhibition of this year. In spite of the increased demand for space and the consequent crowding that must later ensue, exhibitors manifest the same inexcusable tardiness, so that we scarcely hope to see the Fair well under way, with all its departments complete, much before the time allowed for its duration shall have half expired. Although we miss several articles and processes of manufacture that formed prominent points of interest in the exhibition of last year, others have filled their places; so that, in general popularity, there is every reason for the present exposition to equal if not excel its predecessors. The interior of the building, late the Empire Skating Rink but now the property of the American Institute, has been renovated and redecored. No additions to its already large area of floor space have been made, although the mode of arranging the articles in the separate departments is somewhat altered. The general decorations consist of the time-honored red, white and blue draperies, national flags, etc., and the scenic effort of doubtful excellence on the large arch at the further end of the hall. The roof of the building has been painted in appropriate colors, which is a decided improvement over the bare woodwork of former times. The usual Matthews soda water fountain occupies a central position in the hall, and is surmounted by a colossal female figure. The latter, we hope to see speedily removed. In our opinion it has no artistic merit; it is rough and apparently unfinished, while its false or rather want of proportions show a lack of knowledge of anatomy on the part of the modeler which the immense size of the statue renders still more glaring. While

it is possible to obtain in this country the works of such sculptors as Powers, Palmer and scores of others of equal or less note, there is no necessity for forcing into prominence any such caricature on the plastic art. Illumination at night is effected by means of the new oxyhydrogen gas which, carried through the building, gives an admirable light.

In recording our notes jotted down during several visits to the exhibition, we shall, according to our usual practice, begin with the department of machinery, mentioning whatever it contains of novelty and interest, and then proceed through the other divisions in regular succession. Professor R. H. Thurston, of the Stevens Institute, Hoboken, N. J., the author of the excellent series of letters ended in this number of our journal, is the chairman of the Committee of Managers in charge of the machinery. He is ably seconded in the executive portion of his duties by Mr. R. H. Buel, the superintendent of the department, through whose efforts the arrangement of this part of the Fair has been conducted with unusual vigor. Of

STEAM BOILERS,

but three are in position. The small Root safety boiler, on the right hand side of the entrance to the boiler room, is the one used in the previous exhibition. Facing it, is a larger boiler of the same pattern, of 200 horse power. A Phleger non-explosive boiler is also in place, supplying steam. In this generator, there is a constant circulation due to the position of the water tubes, some of which are under the fire, while the internal arrangements are such that dry steam is always afforded. The

STEAM ENGINES

are not so numerous as they were last year. An admirably built 80 horse power Wright horizontal engine occupies the most prominent place and supplies the power to other machinery by means of two 3 inch triangular belts. The latter form a new and effective mode of transmitting power, and are claimed to possess many points of superiority over the flat belt. The best oak tanned leather is used, made, for the above mentioned size of belt, of 5 ply with long laps. For belts of smaller dimensions, 3 or 4 ply leather is substituted. The pair referred to, as used at the Fair, are claimed to equal in every respect the 20 inch single belt of last year. On the opposite side of the passage way from the Wright machine is a 50 horse power horizontal engine, from the Newburgh Steam Engine Works of Messrs. Whitehill, Smith & Co., of Newburgh, N. Y., which is fitted with an adjustable cut-off worked by eccentrics and a Shive's governor, which will be described hereafter.

The Yale Iron Works exhibit a 10 horse power vertical engine which, if we may judge from its noiseless and equable motion, is excellently constructed. The Erie City Iron Works present a 15 horse power horizontal engine, remarkable for its compactness of form. The steam and water pressure engine of Messrs. King & Mulock, of Middletown, N. Y., is a recent invention of very simple construction, having but a single valve. As its name indicates, it can be run by either water or steam pressure, and, it is claimed, at a very low cost. The well known Baxter engine, manufactured by the Colt Arms Company, of Hartford, Conn., is displayed in its various sizes. It attracts a curious crowd, and is the recipient of well merited praise from all quarters. Other excellent portable engines are those from the Ames Iron Works. The larger sizes are especially adapted for use in saw mills. Two machines are exhibited of ten and three horse power respectively.

PROFESSOR R. H. THURSTON'S LETTERS.

The last of the interesting series of letters written by Professor Thurston for the SCIENTIFIC AMERICAN, during his recent western tour, will be found in another column. We much regret the necessity which brings this correspondence to a close, for it has been full of interest to our readers, furnishing them with the latest information concerning the improved processes now in vogue in metallurgy, as practiced at the leading establishments, with observations relating to the situation of the mineral supplies upon which many of the metallurgic industries of our country depend. Our correspondent has arrived at his home in Hoboken, N. J., and resumed his accustomed duties as Professor of Mechanical Engineering in the Stevens Institute.

PATENT OFFICE ITEMS.

Assistant Commissioner of Patents J. M. Thacher, after several weeks' absence, has returned to his post, and will administer the duties of the Commissioner while the latter is away in the West, whither he has gone in the interest of the Government.

Competitive examinations which have recently taken place at the Patent Office have resulted in the following appointments and promotions: Major Z. F. Wilber, lately first assistant examiner in-chief of the class of Mills, Glass, and Clay, has been promoted to be principal examiner in the same class, to fill the vacancy made by the resignation of T. C. Folger; F. L. Freeman, W. Osgood, L. N. E. Cooke, and J. B. Darnall are appointed second class clerks in the examining corps.

Professor H. H. Bates, examiner, has taken charge of the class of Civil Engineering.

CAR COUPLING DANGERS.

The suggestions heretofore made by us on this subject have called forth a variety of communications from correspondents, some of which we shall publish. One of these, signed "Brakeman," will be found in our present number. It is the production of a brakeman now working on the Erie railway, and is a model of excellence. The clear intelligent manner in which the subject is discussed is very creditable to the writer. Communications of this kind, from practical men, we highly value.

Business and Personal.

The Charge for Insertion under this heads One Dollar a Line. If the Notices exceed Four Lines, One Dollar and a Half per Line will be charged.

The paper that meets the eye of manufacturers throughout the United States—Boston Bulletin, \$4 00 a year. Advertisements 17c. a line.

I want a partner with capital in Bolt Machinery, also some parties to make machines with good facilities, fully developed. John R. Abbe, Providence, R. I.

Pipe Cutters, equal to Stanwood's, for cutting off iron or brass pipe. Price, $\frac{1}{2}$ to 1, \$2.50. Apply to G. Abbott, 31 Devonshire Street, Boston, Mass.

Wood turning Lathes, cheap. Wm. Scott, Binghamton, N. Y.

Wanted—A Power Pump to raise water 45 feet into a Tank to supply a 25 H.P. Locomotive Boiler. Send Circular and Price List to D. B. Cade, Jr., Danburg, Wilkes County, Georgia.

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Wm. Burghart, 125 Grand St., Paterson, N. J., wants to find parties who will manufacture a new and valuable invention.

Gear Charts, 50 cents. E. Lyman, New Haven, Conn.

Models and Patterns of all kinds made in the best manner at lowest prices. Geo. B. Kilbon, 35 Market St., Springfield, Mass.

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Tested Machinery Oils—Kelley's Patent Sperm Oil, \$1 gallon; Engine Oil, 75 cts.; Filtered Rock Lubricating Oil, 75 cts. Send for certificates. 116 Maiden Lane, New York.

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The Berryman Steam Trap excels all others. The best is always the cheapest. Address L. B. Davis & Co., Hartford, Conn.

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Steel Castings to pattern, strong and tough. Can be forged and tempered. Address Collins & Co., 212 Water St., New York.

For 2, 4, 6 & 8 H.P. Engines, address Twiss Bro., New Haven, Ct.

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Walrus Leather for Polishing Steel, Brass, and Plated Ware. Greene, Tweed & Co., 13 Park Place, New York.

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American Boiler Powder Co., Box 797, Pittsburgh, Pa., make the only safe, sure, and cheap remedy for 'Scaly Boilers.' Orders solicited.

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