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NEW YORK, SATURDAY, DECEMBER 30, 1893.

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(Illustrated articles are marked with an asterisk.)

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For the Week Ending December 30, 1893.

Price 10 cents. For sale by all newsdealers

THE ALKALI METALS, POTASSIUM AND SODIUM.

Sir Humphry Davy obtained in 1807 from potash, by the action of a voltaic battery of the greatest power which had then been constructed since its discovery in 1800, a brilliant, bluish metal, lighter than water and so soft that it could be welded between the fingers at ordinary temperature, as iron is at high heats by blows of a hammer. He extended his experiments to soda, and found a similar weldable metal, also lighter than water, silvery white in color. That potash and soda were oxides had been suspected by chemists, and this confirmation of the view created great excitement throughout the scientific world. Proof was soon obtained further that all the earthy or basic constituents of the rocks, lime, magnesia, baryta, alumina, etc., are also oxides of metals.

Other chemists, realizing that the electrolytic methods then known could not produce enough of these metals for any practical use, tried to separate the oxygen from the alkalies by furnace operations. French chemists succeeded in decomposing potash by *iron* at high heat, but they obtained a *liquid* metal at first, which was subsequently discovered to be due to the presence of soda as an impurity in their potash—the two alkali metals forming together a permanently liquid alloy. With *pure* potash and iron Davy's solid potassium was obtained, and it was subsequently discovered that at very high heats carbon decomposes potash and soda and their carbonates, the metals distilling over—potassium as a vapor of a beautiful green color, the vapor of sodium being purplish in tint. These vapors are condensed in heavy hydrocarbon oil or melted paraffine wax.

In recent years, by reason of the belief, now general, that the clay-metal aluminum is destined to rank in usefulness with iron and steel, and of the fact that aluminum has been heretofore obtained by the action of sodium on aluminum compounds, an American chemist (Castner) made new efforts to obtain sodium cheaply. He combined iron and carbon, producing a peculiarly intimate mixture of the two. This operates on the carbonate of soda to great advantage, more rapidly and at a lower temperature. Finding but a small market for sodium in America, Castner went to England, and influenced capital to build large works for carrying out his new inventions, which were numerous, and extended to the manufacture of aluminum, as will be set forth in another article. As a result largely of the work of Castner, the following quotations for sodium, in this country, may be cited:

May 12, 1888	$4.50	per lb.
May 25, 1889	2.75	" "
Oct. 26, 1889	2.50	" "
May 30, 1891	2.50	" "
Sept. 24, 1892	50 to 75 cts.	" "
April 25, 1893	50 to 75 cts.	" "
Aug. 19, 1893	$1.75	" "

The latter figure is quoted at the present date. The only reasonable explanation of the sudden rise in the valuation of sodium during 1893 is that it has passed out of use for the making of aluminum, which was its main channel of consumption. The electrolytic methods—such as Davy first introduced—have come back again; and with the potent aid of our magnificent dynamo-electric machinery, the clay-metal is produced much more cheaply by electrolysis. Hence the twenty sodium furnaces of Castner, at Oldbury, near Birmingham, which, according to an article before us, from *Engineering*, produced sodium in the latter part of 1888 at a cost of about 18 cents per lb., have doubtless gone out of use to a great extent. Nevertheless, the fact remains that sodium, which has such wonderful and exceptional chemical qualities and energies, was made for less than the cost of tin. With us, the cost would be a little higher, probably; for, as yet, most of our soda is imported from England. But this should not be so. Soda is made from salt, by the aid of sulphuric acid and coal. Of salt we have far more than England, and of pyrites for making sulphuric acid we have inexhaustible amounts of the highest grades, while she has to ship it from Spain. As to coal, that "goes without saying."

The object of this series of articles being to put before our practical men and inventors objects worthy of their ambition, and suggestions how to realize these, we will first give concisely the qualities of these alkali metals and their present uses, and then suggest new uses; also methods of obtaining them independent of existing methods. The latter, it is only safe to assume, are under the protection of existing patents. Sodium and potassium, and their liquid alloys, all take fire on contact with water, and burn with great violence and energy, and with enormous heat. They must all be preserved under the surface of hydrocarbon oils. A good article of common kerosene will answer. The solid metal ingots are easily divided under the oil with a knife, cutting like hard wax. The liquid alloys, of course, can be poured. Some density figures for solid sodium and potassium were given in SUPPLEMENT, No. 938, December 23, 1893. The mean figure for sodium is about 0·97 (water = 1). The mean for potassium about 0·875. Sodium, when melted at about 208° F., is about 0·929, and at its boiling point (900° F.) 0·744. The liquid alloy is about 0·891. The latter has about four times the coefficient of expansibility of mercury, and of late thermometers have been made with it in England, in an experimental way. These give indications far higher than mercurial thermometers, and the degrees are four times as long. Such thermometers will probably be unsafe for ordinary usage, but invaluable as instruments of scientific research. All these substances when placed suddenly under water explode with enormous energy. They amalgamate with mercury, but with violent explosion. Davy found that such amalgams would coat over iron, steel and platinum, which are in no way enfilmed by mercury alone.

The space for this article being exhausted, the *suggestive* portion is crowded over to the next issue.

THE EXPLOSION OF HIGH PRESSURE GAS CYLINDERS.

One of the interesting developments of technical science is the commercial supply of gases under high pressure. Oxygen and hydrocarbon gases are now compressed into steel cylinders of very small size, relatively speaking. The gas is reduced to less than one one-hundredth of its normal volume. Another example of the same system is furnished by carbonic acid gas. This can be bought in the liquid state, contained in steel cylinders. Faraday's great achievement, one of the triumphs of a life of scientific experiment, is now a commercial process, and is applied to the supply of an everyday commodity.

Oxygen and hydrogen gases will stand unlimited pressures without liquefying. There is a special temptation to employ high pressures in their case, as the volume regularly diminishes as compression is applied. It is customary now to sell the cylinders filled at nearly 1,800 pounds pressure to the square inch. An innocent looking cylinder, less than five feet long and a few inches in diameter, may have locked up within it nearly a thousand tons of total pressure. If such a cylinder gives way, a dreadful explosion will ensue.

Two such accidents have recently occurred, one in Bradford, England, and one in Albany, N. Y. In the Bradford case a boy was transferring two cylinders, dragging one behind him and carrying the other. The dragged cylinder exploded, killing him on the spot and injuring a man. The Albany explosion occurred on December 6, on a dock. A number of cylinders of oxygen and of hydrocarbon gas, called in the trade "hydrogen," were being shipped from New York to Albany. All but one had been taken from the dock where they had been placed. On attempting to remove this it exploded. It is believed that it was thrown down by the man carrying it. One man was fatally injured, two others were hurt, one seriously and one slightly. It was a hydrogen cylinder which exploded. In both cases the pressure of the gas was 120 atmospheres, or 1,800 pounds to the square inch.

In the London *Engineering* of December 8, 1893, a letter has been published emanating from the developer of the process used in making the cylinders originally used for high pressure oxygen gas. He describes his process of pressing the cylinders up from disks of sheet steel of approved quality. At a certain stage of the process a bursting strain of two tons per square inch is applied to detect hidden defects; when finished and annealed, a final test of one and one half tons is given them. The *rationale* of the two tests he does not explain. Such cylinders the writer in question, Mr. Howard Lane, says are worked by the German government up to 160 atmospheres or 2,400 pounds to the square inch. The regular pressure used here and in England is 120 atmospheres, or 1,800 pounds per square inch.

The governments of different countries take cognizance of steam boilers and see that they are tested at proper intervals. No boiler can be legally used without proper permit or license. It would be well both for the public and for the dealers in high pressure gases to subject these gas cylinders to proper tests and examination. It should include the fullest possible tests of the quality of the metal, even if it involved the cutting up of an occasional cylinder. Mr. Howard Lane in the communication referred to claims that the cylinder which exploded at Bradford was made by an opposition company, and was not of suitable material. Not only strength, but ductility of the steel is an important element of safety. If a boiler with perhaps only fifteen pounds pressure per square inch is an object of governmental regulation, a cylinder with one hundred times that pressure is still more so. It is nothing less than a shell charged with an explosive, whose power in destroying life has twice been proved within the last few weeks.

Rough usage cannot be pleaded as an excuse. The shippers of goods always have employed rough treatment and will continue to do so. The cylinders should be of such quality as to stand anything that they may be subjected to.

THE Hoosac tunnel, Massachusetts, is the longest in the United States; length, four and three-fourths mile; cost, $14,000,000.

[FROM ASTRONOMY AND ASTRO-PHYSICS.]

The Planets for January.

Mercury having been at greatest western elongation December 14, will in January be too close to the sun for observation. He will be at superior conjunction January 29, at 6 h. 36 m. A. M.

Venus, which has been such a brilliant object in the early evening sky during the past month, will be still more brilliant during the first part of January. This planet will attain its maximum brilliancy on January 10, when the light will be 218, as compared with 145 on December 1. The position of Venus is becoming a little more favorable for observation in northern latitudes, as the planet moves northward in declination. Venus and the crescent moon will be in conjunction on the morning of January 10, and the two will form a pretty pair on that evening and the preceding.

Mars will be morning planet during January, visible in the southeast after 5 o'clock. The low altitude will prevent good observations in our latitude, but south of the equator something may be done in the study of the surface markings of the planet. Mars and the waning moon will be in conjunction on the morning of January 3, the latter passing 4° south of the former.

Jupiter will be in excellent position for observation during the first half of the night in January. The planet will be stationary among the stars of Taurus on January 15, after which it will move slowly eastward. The "great red spot" was well seen by us with the 16 inch telescope on the night of October 31. Its center was on the central meridian of Jupiter at 11 h. 31 m., Central time, as near as we could estimate. This time agrees closely with that predicted by Mr. Marth. The spot was seen without difficulty, although the color was quite faint. The color was exactly the same as that of the belt just to the south of it, and the two objects merged into one another without the slightest change in intensity of color. The outline of the spot seems to be the same as in past years, except as stated above, that its southern edge is merged into the belt. There seemed to be two white clouds over the central portions of the spot, the following of the two being the larger. The seeing was excellent during this observation and much of very minute detail was seen in all the belts.

Saturn is getting into better position for observation in the morning, but the majority of observers will prefer to wait two or three months until the planet is visible in the evening. Saturn will be at quadrature, 90° west from the sun, January 14. Saturn is in the constellation Virgo, a little northeast of Spica, and is moving very slowly eastward. The moon will be 4° south of Saturn at noon, January 27.

Uranus is in the constellation Libra, a little way east of the star α. It is not yet in very good condition for observation in our latitude.

Neptune, having passed opposition in December, will be in excellent position for observation in January. It will move very slowly westward during the month, the position January 1 being a little more than one-third of the distance on a straight line from ι to ε Tauri. There is no star of equal brightness within a radius of 1°.

November Meteors.—The November meteors were far more abundant this year than I have ever seen them before. Especially were they plentiful on the mornings of November 13, 14, and 15. Many very brilliant ones were seen. One on the morning of the 14th burst just below Coma Berenices It was nearly as large as the full moon. On November 15, at 14 h. 50 m., a splendid meteor from Leo shot across the sky and burst between Zeta and Eta Ursæ Majoris. This left a persistent train about 10° long, which remained bright and straight for about five minutes, like a slender comet; it then collected into a cloudy mass at the point of explosion. This elongated mass of luminosity remained distinctly visible for half an hour, drifting due east in the meantime about 7°. As I was photographing the comet at this time I could not turn my telescope to it to see how long it remained visible after it had ceased to be seen with the naked eye. E. E. BARNARD.

Mt. Hamilton, November 19, 1893.

George A. Hill, United States Naval Observatory, Washington, D. C., has been appointed to the position of assistant astronomer in the observatory. He is now at work with the Prime vertical transit instrument. He takes the place of A. Hall, Jr., who resigned not long ago to accept the position of director of the Detroit Observatory at Ann Arbor, Michigan.

Professor S. W. Burnham.—At a recent meeting of the board of trustees of the University of Chicago, Mr. S. W. Burnham was unanimously elected professor of practical astronomy. The department of astronomy is to be congratulated on securing Professor Burnham's eminent services, and the honor which the university authorities have thus done to the cause of science will be fully appreciated by astronomers everywhere, who will rejoice to learn that Professor Burnham will again have adequate opportunities for continuing his splendid investigations in double star astronomy. It is understood that the micrometrical measurement of double stars is one of the principal lines of research contemplated with the great 40 inch refractor of the Yerkes Observatory.

Stephen Wilcox and George H. Babcock.

On November 27, Stephen Wilcox, one of the founders of the Babcock & Wilcox Company, the well-known engineers and boiler manufacturers, died at his home in Brooklyn, N. Y., after a brief attack of pneumonia. It was said of him that he had a simple, genial nature, which would know nothing but the right, whatever the interests involved, besides rare mechanical ability. He was born at Westerly, R. I., about sixty-three years ago.

Within a few days following, on December 16, at Plainfield, N. J., occurred the death of the other of the principal members of this firm, Mr. George H. Babcock, in the 61st year of his age. He was among the first to invent a press for chromatic printing, and during the war invented a shrapnel shell.

Mr. Babcock had been married four times. Last summer he married Miss Eugenia Lewis, a teacher in the Plainfield public schools. He had been president of the Plainfield Board of Education since 1885. He was a lecturer in the mechanical engineering course at Cornell University, and a member of the New York and Plainfield Camera clubs. Some of his lectures in the engineering course at Cornell have been published in the SCIENTIFIC AMERICAN SUPPLEMENT. He was an art critic, and his home is filled with choice works. Several of his collections were exhibited at the World's Fair. He leaves one child, a boy eight years old.

The Social Condition of Workingmen.*

BY RALPH D. ST. JOHN.

The "Seventh Annual Report of the Bureau of Labor," at Washington, has been recently published. The report relates to the cost of producing textiles and glass in the United States and in Europe; to the wages paid to the persons employed in these industries; and to the cost of living of the laborers. My object is to draw from the tables in the report some inferences as to the real condition of American laborers, and as to the relation existing between their condition and the cost of living. The following details are taken from the cotton, the woolen, and the glass industries.

It is found that in the cotton industry, of the 2,132 families considered, 168 owned their house. The average size of the family was 5·7 persons. The average total yearly income for each individual was $114.70, the expenditure $106.48. Of the whole number of families, 765 came out at the end of the year with a deficit, which amounted on an average for each to $54.16. Averaging the total surplus among the 1,151 families who had accumulated, it gave as the share of each $123.33. The average expenditure for food was $287.06 a family, or $50.06 an individual. The total cost of living, other than for food and rent, was $258.79 a family, or $45.13 an individual.

In the woolen industry, 911 families were considered, of whom 154 owned their house. Average size of family, 4·9 persons. For each individual, the average total income was $136.49; the average expenditure $122.28. A deficit was traced to 268 families, of the average amount of $61.49; and a surplus of $136.16 to each of 583 families. The cost of food was $262.85 a family, $54.10 an individual. Total expense, other than for food and rent, was $256.32 a family, $52.76 an individual.

In the glass industry, of the 1,276 families visited, 339 owned their home. Average number of persons in each family, 4·8. For each person the average income was $177.81, the average expenditure $159.07. An average deficit of $92.59 was traced to each of 453 families; 766 families had each an average surplus of $205.65. Cost of food was $294.75 a family, $60.97 an individual. Besides cost of food and rent, the expenditure was $394.37 a family, $81.57 an individual.

These figures show that, so far as financial considerations go, the three industries, in the order given, form an ascending scale. They also show that, as far as actual financial results are concerned, they all compare favorably with the general estimate which any observing person would make of the condition of the majority of people in any calling throughout the country.

I will pass now to more specific cases, with the object of seeking out the causes of the sufferings of which some working people complain. I shall trace out some of the statements concerning certain individuals and compare and contrast them.

Of two families living in Alabama, and connected with the cotton industry, it is learned that both are of American birth. Of the one designated in the tables as No. 9, the husband, aged forty-seven years, is a section hand; the wife and three children are all at work. The husband's income is $257.58. the wife's $15.63, the children's $333.56; total income, $606.77. They do not own their house. For their food, the itemized bill amounts to $261.60. For expenditure other than for food $39 goes for rent; $28 for fuel; $6 for lighting; for clothing for the husband $5, for the wife $5, for the children $45; furniture and utensils $43. The total expenditure is $562.45. Under the table of notes, in which running comments on the condition of each family are made, it is said: "They live in squalor."

In the other family, No. 35 in the tables, the husband, aged forty-six, is a carder, receiving $257. The wife stays at home, but takes boarders and lodgers, earning thus $236; the only child, a son, earns by work $120. Their itemized expenditures for food reach the amount of $279. The rent is $24, fuel $32, lighting $15; clothing for husband $12, for wife $15, son $5; furniture and utensils, $1.50. The total expenditure is $443; the surplus is $170. Their cabin is described as neat but crowded, and they have a garden.

The difference in the circumstances, under conditions quite similar, shows that the latter family have at least one of the secrets of the capitalist's success, while the other swells the list of the most miserable people in the land.

In two families of Irish nationality, living in Illinois and working in the glass industry, greater differences still are found. In one case, the husband, aged forty-two years, is a mixer; the wife remains at home; three children are at work, two at school, and two at home. The husband receives $349, the children at work $317—total income $666. Total expenditure for food, $187.40; other than food, $278.65. In the latter amount are comprised the following: Taxes, $11.50; insurance on property, $1.50, on life, $14; for religion, $1; for charity, $1.50; books and newspapers, $6.70; amusements and vacations, $10; intoxicating liquor, $26; tobacco, $5.20. Their surplus is $200, and they own their house and garden, a sewing machine, and a cow.

In the second family, the husband, aged thirty-three years, is a blower, and receives $1,449.52. The wife and three children are not wage earners. The amount spent for food is $352, other than for food, $1,097.52. In the latter sum are included: Rent, $120; labor organizations, $34.18; religion, $2; charity, $15; books and newspapers, $6.50; amusements and vacations, $30; intoxicating liquors, $400; tobacco, $52; sickness and death, $27; other expenses, $60. Total expenditures reach $1,449.52, just balancing income. One other item needs to be mentioned. In the former family the bill for clothing ran, for the husband $20, the wife $15, children $50; in the latter family, husband $125, wife $40, children $65. The remarks in the report concerning the second family are: "Wretched people, miserable home."

In this comparison the earmarks indicate a selfish, drunken husband, as the cause of the misery of the second family. It is a pity that any account of liquor entered into the first report, but it is the aim of this article to take in all particulars, average instead of extreme cases, which makes it necessary to note many things to be deplored.

The tables in the seventh, as well as in the sixth report, show that the misery often to be found existing among the working people cannot be attributed to the cost of living, or rather to the disproportion between their earnings and the cost of living. The majority of those who are classed among the destitute are to be found, it is true, among those receiving the smallest wages; but that this does not necessarily follow is proved by the fact that some of the poorest paid laborers are recorded as living in good circumstances, and as having accumulated quite a property, while others receiving the best pay are in the most miserable condition.

Thus we come by this new route to the old lesson, that the cause for the misery or the happiness of men lies within themselves and not in outward circumstances.

* Condensed for the *Literary Digest* from a paper in the *Chautauquan*, Meadville, Pa., December.

Staff in the Alhambra.

There is a general impression that staff, the material so abundantly used for the rich-looking architectural works of the great Exposition, is of French origin. But it appears to have been introduced into Europe by the Arabian Moors, and much beautiful work composed of this or kindred material is still extant in Spain. Some of the finest examples are to be found in that grand historic old Moorish fortress the Alhambra, at Granada, which was finished and decorated about the year 1348. Washington Irving, in a note in his delightful volume "The Alhambra," says:

"To an unpracticed eye the light relievos and fanciful arabesques which cover the walls of the Alhambra appear to have been sculptured by the hand, with a minute and patient labor, an inexhaustible variety of detail, yet a general uniformity and harmony of design truly astonishing; and this may especially be said of the vaults and cupolas, which are wrought like honeycombs or frost work, with stalactites and pendants, which confound the beholder with the seeming intricacy of their patterns. The astonishment ceases, however, when it is discovered that this is all stucco work; plates of plaster of Paris, cast in moulds and skillfully joined so as to form patterns of every size and form. This mode of diapering walls with arabesques and stuccoing the vaults with grotto work was invented in Damascus, but highly improved by the Moors in Morocco, to whom Saracenic architecture owes its most graceful and fanciful details."