and sung on her 101st birthday anniversary. Her digestion and appetite were good, and it saddens the social philosopher to think that if Sarah had not indulged in this terpsichorean revelry she might have lived many years longer. She was an early riser, like almost all centenarians, drank beer occasionally (that probably was the cause of the dancing), but did not smoke or take snuff.—William Kinnear, North American Review.

CALORIMETER FOR TESTING COAL.

COMPARISONS of evaporative tests, obtained with different classes of fuel, are of little practical use unless the precise value of the fuel employed in each case is known. Hitherto there has been too much of the rough and ready character in connection with the com-

parisons of evaporative tests, though we are pleased to note, in connection with modern boiler trials, the importance of accuracy in observation and measurement, not only as to the quantity of water evaporated and coal consumed, but also with respect to the quality of the fuel, and the constitution of the gases is now much more fully recognized.

The use of the calorimeter or other apparatus for determining the exact heating power of a fuel is now much more general. Its services are of importance, not only in connection with boiler tests, but also for determining the efficiency of various classes of fuel. There are several varieties of calorimeter, and we illustrate herewith the one known as Thompson's, which has been largely adopted by railway, colliery, and steamship companies, and is a favorite with many engineers and chemists on account of the rela-

CALORIMETER
IN
ACTION.

bility of its results and the ease and rapidity with which they may be obtained.

The principles upon which Thompson's calorimeter or coal-testing apparatus are based are—first, that the latent heat of steam is equal to 967 deg. Fah.; and secondly, that coal or other fuel burned in pure oxygen evolves the same amount of heat as when perfectly consumed in atmospheric air. The experiment is made thus: A measured weight of fuel is finely powdered, dried, and intimately mixed with a proportionate weight of a mixture consisting of chlorate and nitrate of potash, and is placed in a small copper furnace primed with a fuse, as shown at F, covered with the

cylindrical combustion vessel, G, and immersed in a given weight of water contained in the glass jar, H. After a few seconds the fuse ignites the mixture of coal and potash, and the products of combustion, passing through the water in a finely-divided state, communicate the whole of the heat to the water. The temperature of the water is duly noted at the commencement and end of the experiment, and it is only necessary to multiply the weight of the water by the number of degrees of heat communicated to the water to have the calorific value of the fuel in calories. The evaporative duty—that is, the amount of water capable of being converted into steam per pound of fuel burnt—is directly as the elevation of temperature. Thus, if the thermometer showed a rise of 7.5 deg., then 1 lb. of fuel would evaporate 7.5 lb. of water.—The Practical Engineer.

THE COMPACTUM EVAPORATOR AND DISTILLER.

WE have recently had an opportunity, says the Engineer, London, of inspecting a complete evaporating and distilling plant, such as is being fitted in vessels of the torpedo destroyer class, and which is entitled to some notice on the score of efficiency, light weight and general compactness—a combination especially valuable in these small engine rooms.

Our illustration shows the plant as designed and manufactured by Messrs. John Kirkaldy, Limited, West India Dock Road. About this plant the following figures are of interest: The total weight of the plant, with water at requisite height, is only 1,841 lb., disposed as follows: Evaporator, 1,180 lb.; pump, 206 lb.; distiller, 120 lb.; water, 330 lb.; the necessary spare gear would add 134 lb., bringing up the entire total to 1,975 lb. The height is 5 ft. 11 in.; greatest width, 4 ft. 4 in.; and depth, 2 ft. 9 in. When it is borne in mind that the "feed makeup" produced is 10 tons per diem, and that produced for drinking purposes another two tons, the weight of this machine for these outputs seems strikingly low, and shows how much Mr. Kirkaldy has achieved by constant and careful improvements.

It is not many years since Mr. Kirkaldy put into practice his ideas concerning the importance of heating feed water by methods which kept the water free

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from oil and other impurities, whether the heat for the purpose were obtained by exhaust or by live steam, and he proved that the latter might often be used with advantages which, under some circumstances, became economical advantages. For a long time the use of live steam for this purpose was derided, but now the advantages are generally acknowledged, and Mr. Kirkaldy's methods and apparatus widely employed.

The successful working of some feed heaters and makeup feed evaporators has only been achieved by minute attention and special devices, which long experience and new inventions have made possible, and there are probably no manufacturers who have done so much in initiating and developing these now indispensable adjuncts to the high pressure marine engine as the one to whose works we now refer. It is not only for the supply of water for potable purposes on board ship that evaporator or distiller plant is used, but for the much larger supply for boilers, which could not now be worked without this means of supply. Previous to the manufacture of the compact apparatus made by Mr. Kirkaldy, the space required for plant for so large a supply would have prohibited its use. The employment of these feed heaters supplied with live steam and placed between the feed pump and the boiler has afforded most important aid to economical marine engine working. Live and exhaust steam feed heaters and various forms of condensers are made on the Kirkaldy system for electric light stations, and for many places where the possible life of boilers is now, in consequence, much greater than would have been possible with high pressures without such aids.

THE DUSTING PROCESS.

By H. H. BUCKWALTER.

HAVE you ever tried making pictures by the "dusting" process? If you have not, you have missed one of the easiest and most fascinating processes in photography. Contrary to most other methods, its cost is almost nominal, while the range of application embraces some results not obtainable by any other method except at considerable cost and requiring much practice and ability.

The process consists of forming an image in an adhesive substance whose "stickiness" varies with the lights and shadows in the negative. After the substance is properly printed upon, a powder of almost any sort or color is dusted on the image, and is caught and retained in varying proportion as the light affected the original coating. Bichromate of ammonia is the sensitizing substance, and the adhesive mixture is composed of gum arabic and glucose. After the image is properly "developed" in the powder forming the picture, it may be removed from its original support and transferred to another, and, if the powder is suitable, the image may be burned into porcelain or metal and form the most durable photograph possible to obtain.

The sensitive solution is not affected by light while in a liquid state, but it is possibly advisable to keep it on the darkroom shelf, or at least away from direct sun-

shine. While an ironclad formula is not imperative, the following is suitable:

Water, hot.....	3 ounces.
Powdered gum arabic.....	75 grains.
Glucose.....	1 even teaspoonful.
Ammonium bichromate, 2 drachms, dissolved in ½ ounce of water.	

Mix thoroughly in the order named. The glucose is generally so thick and difficult to handle that it is impossible to give a certain proportion by weight. After the whole has been thoroughly dissolved, the solution should be filtered through paper, and every precaution taken to avoid dust. About the only possibilities of failure lie in dust and air bubbles in coating the plate, so the operations should be conducted accordingly.

Thoroughly clean a glass plate—an old negative glass will do. After drying the plate, the solution may be poured on in similar manner to flowing collodion. A thin, even coat is desired, but the thickness does not make much difference, except in convenience in drying. After coating, the plate should be dried at once. The writer's method consists in moving rapidly over a gasoline stove and keeping the plate constantly in motion in every direction, and almost horizontal, to avoid drying in streaks. There is no danger from frilling. This operation should be conducted by lamplight or very subdued daylight, for as soon as the plate is dry it is considerably more sensitive than silvered paper.

After the film is dry the plate may be kept for a few days, but preferably, should be printed at once.

The whole operation of coating and drying should not consume more than from three to five minutes, and, therefore, very little can be gained by coating in advance, while some advantage is apparent from freshly coated plates.

Almost any good negative of medium density may be used. One with transparent detail in high lights will give excellent results in most subjects. The sensitized plate is placed in the frame under the negative in the usual way and printed in direct sunshine for from forty-five seconds to one minute; in shade or diffused light, a proportionally longer time. By electric arc light, from five to eight minutes at a distance of two feet will probably be about correct, but most operators will use sunshine in preference. After printing, the plate is taken from the frame in subdued light, and a small quantity of powder is dusted upon it. For experiment, a fine bronze will answer very well, in fact, it is preferable for most subjects. With a camel's hair duster or tuft of cotton the powder is moved around over the plate. If it does not adhere properly, the image can be "developed" by breathing on the film and gently dusting the powder over the spots breathed upon.

After the whole image is up, a small amount of "doctoring" can be done. Too much local density can be remedied by gently rubbing with a piece of soft chamois, while weak portions may be brought up by a proper application of breath followed by powder.

Contrary to other photographic processes, a "reversed negative" is obtained by the above method of printing. But this is capable of giving exceedingly pretty effects in statuary and similar subjects, and even in some landscapes the effect is good.

Immediately after "development" the plate should be flowed with collodion, either plain or "leather," the latter containing a small percentage of castor oil. As soon as the collodion coating has set, the plate should be immersed in clean water, in a tray, and the yellow color soaked away. Several changes of water will effect this, and make the image permanent, in fact after thorough washing, the glucose film will be removed entirely and the image will then consist entirely of the powder with a coating of collodion.

After the yellow color has been removed, the plate may be dried and a black varnish flowed over the back or a piece of black paper placed in the same position. This will answer very well where the image is formed from a plain negative. If a positive is used to print from, the image will then be developed into a gold statue (for example) on a background of black or the color of the mount. Any other color can be used, of course, instead of the gold bronze. The color of the background will depend on subsequent operations if plain glass is undesirable.

Now, about transferring. If thick flexible (leather) collodion is flowed over the plate, just previous to removing the yellow color, and the operation carefully conducted, the whole film may be removed from the glass and placed on another support. The removal of the film may be facilitated by scratching away a narrow border around the edge of the plate, thus allowing the water to get under the collodion and freely dissolve away the glucose layer. Then the whole film may be gently pushed from the glass, and a piece of porcelain or other support may be slipped under the film, which may be placed where wanted, and the whole removed from the water. A piece of hard, clean blotter is then placed on the film, and all the water carefully rolled out.

If the final support is porcelain or light colored celluloid, the image may be developed up with lamp black, powdered charcoal, insoluble Prussian blue or similar powders. Any powder insoluble in water will answer. For burning in porcelain, special powders give the best results. They may be obtained in almost any color from dealers in artists' materials. For black, however, lampblack will generally answer.

While the writer has never had occasion to try the process on lantern slides, the method seems to suggest some possible advantages. The amateur may consider it superior on account of the cost, for if one print is ruined or defective, it can be removed and the glass at once coated without much expense. For the decoration of lamp shades, paper weights or similar articles, few other processes bear comparison in any way, for nearly all are limited as to color and delicate in their manipulation.—The Photo-American.

THE RELIANCE BUILDING, CHICAGO.

BUT little has as yet been published in Europe concerning the lofty office buildings which are so characteristic a feature of the larger American cities, and this has led our London contemporary, Engineering, to give the following interesting description of one of the most recently erected examples. The Reliance building, the subject of our notice, is situated on the southwest corner of Washington and State Streets, Chicago, the site measuring 55 ft. on State Street by 85 ft. on Washington Street. There had been a five story building on this site of very heavy masonry construction, the lower floor of which had been used for a bank. The leases of the upper floors expired May 1, 1894. In 1890 plans were made for a 16 story building, and the foundations and first story of this new building were then put in, the upper four stories of the old building being held up on screws while the first story of the new building was slipped in under them. The original plans were somewhat revised this past spring and the building changed to 14 stories, as shown on Fig. 1.

On May 1, 1894, the old building was taken down to the second floor, and the new building is being erected from the second floor up. The tenants of the first floor and basement—a dry goods firm—remain in their store and keep it open for business during the period of construction. Subsequently to putting in the first story, the owner of the ground and building, Mr. W. E. Hale, sold the ground to Otto Young for \$480,000, and leased it back immediately for 198 years at \$24,000 a year, 5 per cent. of the purchase price. Mr. Hale is putting up the new building, and Mr. J. H. Gray, C.E., of Chicago, is the engineer responsible for the ironwork.

The building being very narrow compared with the height, viz., 55 ft. wide and 200 ft. high, especial attention has been given to designing the framework, which is of steel, and which carries the outer walls of the building. For wind bracing, instead of tension rods,

which had been used heretofore, it was determined to put plate girders 24 in. deep at each floor between the outside columns, thus binding the columns together and transferring the wind strain from story to story on the table leg principle. These plate girders are bolted to the face of the column, and form a perfectly rigid connection with the column. The columns are in two story lengths, and adjoining columns break joints at each floor. Every piece of iron in the construction, including all the roof beams, is thoroughly fireproofed, with porous fireproofing. Each piece of fireproofing around the column is wired to the column with copper wire.

The exterior of the building is white enameled terra cotta and plate glass. The windows were made as large as the situation of the columns would allow, and the position of these was fixed by the fact that they had to correspond with the columns of the old building, and so are not as well arranged as they might otherwise have been. The interior of the building will be the most elaborately finished of any building in Chicago. The woodwork is of the finest mahogany; the floors are marble mosaic; the halls above the second floor are white Italian marbles, and in the first and second floors colored marbles. The general plans of a couple of these floors are shown in Figs. 2 and 3, while the arrangement of the steel girders will be best understood from Fig. 4.

The Z bar column, with its horizontal cap plates breaking the column in two at every story, was discarded in this building, and a new column used, composed of eight angles. The cast iron columns, so dear to our British architects, have been abandoned in all good work in the States, and have led to the design of many different types of columns built from rolled sections of steel. Special attention is paid to the question of making easy connections between the girders and these columns, and for most purposes standard

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connections are used—a plan which favors cheapness of construction. A favorite type of column for office buildings has been the Z bar column mentioned above. The column which has replaced this form in the new building is the design of Mr. Gray, and consists of a number of angles riveted together. A large number of tests on full-sized specimens have been made at the Keystone Bridge Works with perfectly satisfactory results, and from these it has been found that for all sizes of column the safe load can be taken to be

$$\left(17,100 - 57 \frac{l}{r}\right) \text{ lb. per square in., where } l \text{ is the length}$$

and r the radius of gyration of the column, the ends of which are taken as fixed. The ends of this column were planed off and connected by means of vertical splice plates. A clause in the specification will show the requirements in this particular, which is as follows: "The columns will be made in two story lengths, alternate columns being jointed at each story. Sections of materials are to be designated on the drawings. The quality of material will be as hereinafter specified. The column splice will come above the floor, as shown on the drawings. No cap plates will be used. The ends of the columns will be faced at right angles to the longitudinal axis of the column, and the greatest care must be used in making this work exact. The columns will be connected one to the other by vertical splice plates, sizes of which, with number of rivets, are shown on the drawings. The holes for these splice plates in the bottom of the column shall be punched $\frac{1}{8}$ in. small. After the splice plates are riveted to the top of the column, the top column shall be put in place and the holes reamed, using the splice plates as templates. The connections of joists or girders to columns will be standard wherever such joists or girders are at right angles to connecting face of column. Where connection is oblique, special or typical detail will be shown on the drawings."

This column also being open from top to bottom, admits of putting the pipes in the corners of the column, and inclosing them with the fireproofing surrounding the latter. There is ample space for this. The connections of the plate girders to these columns are standard in nearly every instance.

The system of plumbing used in the Reliance building is the Durham. In this all the vertical risers, wastes, vents, and downspouts are of wrought iron pipe, coated inside and outside while hot with coal tar varnish. All pipes above $1\frac{1}{4}$ in. in diameter are lap welded, and all are fitted together with screw joints. All pipes for carrying sewage in the ground under the building are of light cast iron, cast in 12 ft. lengths, coated inside and outside by the same process employed in coating water pipe, and put together with lead joints. The depth of the basement brings its floor much below the level of the sewer in the street, and also necessitates sub-drainage under the basement floor, which is ordinary agricultural tile surrounded by broken stone inclosed in a light box frame of wood to keep it in position and alignment. This subsoil water, together with the waste from the fixtures in the basement, water closets and lavatories, and also from all lavatories throughout the building, with the exception of those in main toilet rooms on the seventh floor and lavatories adjoining the pipe space, flows to a pair of Shone ejectors of fifty gallons capacity each, placed below the basement floor, and thence it is pumped into the sewer in the street. The wastes from all toilet rooms, together with lavatories adjoining the pipe space, are taken down in a separate stack and connected direct with the street sewer, as is likewise done with the pipetaking away the roof water. All fittings for the pipes carrying wastes are of cast iron, threaded, and properly coated. When used on a pipe laid to a grade, this grade is cast on. All changes in

direction are made with curved and Y fittings. Hand holes or rodding holes are provided in abundance, and in the toilet rooms all fixtures are set away from the wall about 18 in. to allow working room behind them in case of stoppages, thus obviating the necessity of taking down marble partitions or backs, and tearing up the floor.

As the pressure maintained in the city water mains will not raise water much above the second floor, it becomes necessary to pump the water for the remaining floors. A small pump, 10 in. by 6 in., is placed in the basement, and takes its supply from the large tank, fed direct from the city mains, and raises the water to two boiler iron tanks placed in the attic, and having a capacity of 1,000 gallons each. From these tanks it is distributed to the different points required. A large hot water heater, situated in the basement, is also fed by these tanks, and the hot water is carried back to the attic before being distributed, so as to avoid pumping. The circulation is maintained by cross connecting the hot water boiler with the foot of each hot water riser. All water pipes are of galvanized iron. As, with few exceptions, these waste, ventilating, hot and cold water pipes are located in the angles of the channels forming the columns, there is grouped in each column a complete system of plumbing, and in placing fixtures for the use of offices, long horizontal runs are avoided, and repairs reduced to a minimum. All fixtures in the rooms are set without casing, the exposed connections being of polished brass. All pipes are filled with water and carefully examined for leaks before being cased in the columns.

In the basement of this building are to be placed two high pressure boilers of 100 horse power each, which will furnish steam for all the necessary pumping and steam heating. The building is to be heated throughout by direct radiation supplied on the low pressure overhead system. The main riser is 8 in. in diameter and passes up the pipe shaft to the attic,