For the Scientific American.

**New Chemical Law.**

No. 12.

Proceeding in the same manner for the formation of another aggregated series, as we did for the formation of the aggregated series composing nitrogen, chlorine, bromine and iodine, we may probably derive the following aggregated series, produced by the aggregation of a radical possessing an atomic weight of 7.6.

Phosphorus 7.6X4=30.40. specific gravity 1.77, boiling point 550°. solid.

Arsenicum 7.6X10=76.00, sp. grav. 5.96, solid.

Antimony 7.6X17=129.20, sp. grav. 6 80, solid.

Bismuth 7.6X28=212.80, sp. grav. 9.90, solid.

These substances also possess similar chemical properties. When phosphorus is exposed to the atmosphere, it emits a peculiar odor of garlic, which is exactly the case when arsenic is heated in contact with the air, but as we proceed higher in the series no such odor is emitted. Their specific gravities it may be seen are on a regular increase, and the same may be said of their boiling points. Although arsenic sublimes at the temperature of 356°, yet it is probable that its boiling point is much higher, as it is certain that its melting point is much higher than its sublimation point.—The gradual increase of similarity continues up to bismuth, and although bismuth may possess no apparent connection with phosphorus yet the chain of similarity is complete, phosphorus being similar to arsenic, arsenic to antimony, and antimony to bismuth. The other conditions required of an aggregated series are also fulfilled. It may also be seen that this class, like the previous one of sulphur, &c., gradually increases in metallic properties, thus phosphorus is a non metallic substance: as the series increase the metallic properties increase, as may be seen in Arsenicum, antimony and bismuth. The decrease in affinity as the series increase, may be plainly seen in the affinity of these substances for oxygen. Thus phosphorus has such an affinity for oxygen, as often to enter into spontaneous combustion at common temperatures, while arsenic only requires a moderate heat to oxidise and form arsenious acid, but antimony requires a still greater heat before it forms antimonious acid. Bismuth also requires a great heat to oxidise. The following example shows the atomic weights of these substances, as produced by calculation and experiment.

| | By Calculation. | By Experiment. Kane. | Turner. |
|---|---|---|---|
| Phosphorus | 7 6X4= 30.40 | 31.44 | 31 40 |
| Arsenic | 7 6X10= 76.00 | 75.34 | 75.40 |
| Antimony | 7.6X17=129.20 | 129.20 | 129.20 |
| Bismuth | 7.6X28=212.80 | 213.30 | 71.00 |

There is considerable doubt among chemists, as to the true position of the atomic weights of arsenic, phosphorus and bismuth—some considering the atomic weights of phosphorus and arsenic one half of the numbers given above, and bismuth one third.—This law plainly indicates that the atomic weights as given above are correctly situated, which is in accordance with recent views on the subject. The following example shows the constitution of their acids, by which it may be seen that an equal number of atoms of oxygen are required to form an acid, according to the requirements of the law.

| | Sp. Gr. | |
|---|---|---|
| Phosphoric Acid | 4R+O5. | 2 987 | solid. |
| Arsenic Acid | 10R+O5. | 3.391 | solid. |
| Antimonic Acid | 17R+O5. | 6.250 | solid. |
| Bismuthic Acid | 28R+O5. | | solid. |

These substances will upon examination, also show a perfect chain of similarities. No boiling points are given. Arsenic acid and phosphoric acid produce combinations with water, showing a close similarity. The following gives an example of their sulphurets.

Sulphuret of Phosphorus

Sulphuret of Arsenic 10R+S3. yellow solid.

Sulphuretof Antimony 15R+S3. orange yellow solid.

Sulphuret of Bismuth 28R+S3. grey solid.

The compounds of sulphur and phosphorus have not been sufficiently investigated to ascertain their composition. The following is an example of their chlorides.

Chloride of Phosphorus 2R+Cl.3. liquid.

Chloride of Arsenic 10R+Cl.3 liquid.

Chloride of Antimony 17R+Cl.3. solid.

Chloride of Bismuth 58R+Cl.3. solid.

The specific gravities and boiling points of these substances probably increase. Their similarity with one another is also perfect, and they also increase in general density—the first two being fluids and the last two both solids resembling butter, and termed the butters of antimony and bismuth. Other compounds exist of this class resembling each other in their chemical properties. Thus they all, with the exception of bismuth unite with precisely three atoms of hydrogen, to form gases, also resembling each other in their chemical properties. The probable reason of no compound of bismuth with hydrogen having been discovered, is owing to the 11th section of the law, it being the highest substance in the series.

S. N.

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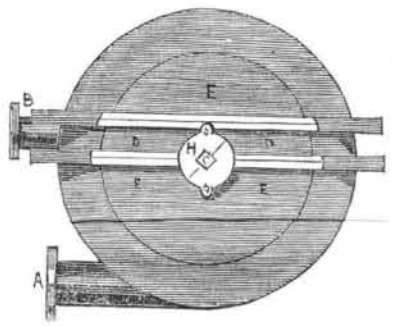
**History of the Rotary Engine.**

*Prepared expressly for the Scientific American.*

HORNBLOWER'S ROTARY ENGINE.

FIG. 22

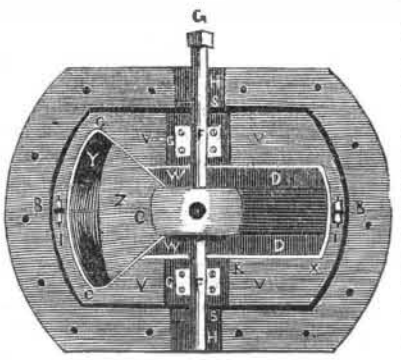


This is a second rotary engine invented by the ingenious Jonathan Hornblower and patented we believe in 1803. It is a steam wheel of curious construction and described by Dr. Gregory in his Mechanics, but as the description is necessarily long, we forbear making any comments.

Fig.22 a cast iron globe with flattened poles. Fig. 23 is an interior view of fig. 22 and Fig. 24 are the parts that move round within the steam iron globe. The pipe A, at Fig. 22 receives the steam from the boiler, to which is connected a valve box, of any usual construction, by which to regulate the admission of steam. At B the eduction pipe is connected, leading from the upper apartment to the condensing apparatus, and turning in such a direction as may be most convenient for the discharging pump to be brought by means of an arbor, turned by the axle of the machine, on which arbor is a small fly wheel, for the purpose of regulating the inequality of the crank to which the pump rod is attached. D D is a middle part of the steam vessel, furnished with flanges for the purpose of screwing it to E E, and also for receiving the lid; by which means the partition within is secured to its place in the middle of the machine, and the lid may easily be removed for the purpose of rectifying and repairing the internal structure. G is the square part of one end of the axis of the machine, over which is placed a gland H, divided into parts, in order that it may be put on over the square, and properly embrace the round part of the axis. Within this gland is a stuffing-box for the purpose of keeping the axle both air and steam tight. In one side of the lower appartment of the steam vessel is a small opening, secured by a lid, for the purpose of cleaning that part of the machine.

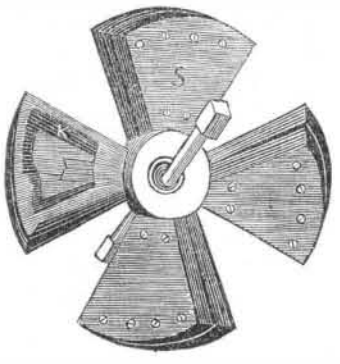
Fig. 23 represents the partition within the steam vessel, which may be made either of brass or iron, or of both those metals combined. B B, is the lower flange, the upper part being taken away. C C, are the two openings or passages for the vanes: these the inventor calls vane-ports, and to obtain a proper idea of the figure. it must be observed that the largest vane-port is formed by the exterior portions of two cones Z, and at Y, by a portion

FIG. 23.



of the concave part of a sphere. The extent of this passage throughout must at least be equal to ninety degrees of a circle, and the vanes of a sufficient width, so that two of them may always make their entrance into the vane ports before the other two make their exit. The edge, C C, may, therefore, be supposed to descend into the lower apartment one half of their depth, and to rise the other half to meet the eye; but it is not necessary that Z be so deep all the way as Y, but converge towards the centre of the machine. This is the ascending vane port; the descending one is included between D D, which are rabbets or seatings for receiving a packing; and X represents a rising edge, so as to obtain a depth at least equal to the thickness of the vanes; one half of which edging is below, and the other half above the main axis. These edges receive two metal plates, fixed down with screws on them, for the purpose of confining the packing. The part E is also formed spherically, and is provided with a packing groove which meets the edge of metal in the middle of the vanes, K, Fig. 24. F F, is the main axle of the machine, laid in its place without the vanes; one end of which is to perform the work required, and the other is applied to the discharging pump. At D D, the packing extends to W W, so as to embrace the nave as well as the descending vane, by which means both the nave and the vanes move steam tight in their revolutions. V V V V is that part of the partition which forms a plane at the axes of the globe, and is secured in its place by being seated in a rabbet with the usual jointing materials on the interior margin of the steam vessel. G G, are two brasses let down into the partition, and they are raised or depressed by screws as adjustment may require. At T T, spaces are left for packing round the axle; and the upper brasses which keep down the axle serve also to keep it in its place. At H H, are the stuffing boxes mentioned in fig. 22; they have a division plate of metal in them, so that S S, being applied with steam from the valve box, the packing

FIG. 24.



of each side of these vacuities are rendered air tight. The manner in which the partition and vane ports are constructed, is by rivetting the two V V V V, together, by means of flanges at I I, first having mounted them on an axis, to correct, by turning, (either by hand or otherwise) the want of smoothness and truth from the casting; and when this is done the main axle is fixed to its place as a guide by which to set up the four vanes, as at Fig. 24, where, by a mere inspection, it is plain how this is performed. The open vane exhibits a frame of metal, which receives a plate on each side: these plates, with the edge of metal, C, cast with the frame, form grooves and vacuities to receive the packing. The nave being hollow receives two iron axles, which are curved in the middle, and there cross each other.

The manner in which they receive the vanes is shown by the figure; also how the packing renders them steam tight on the spherical part of the nave, and that when one of them is moved, its opposite vane on the same axle must be moved. The main axle is turned true by rivetting the two parts together at the nave, and re-rivetting them after the cross axles are set in their places All the several parts of the machine being then put in their respective situations, it is very evident that when steam is admitted into the lower apartment the rising vane, which occupies the largest passage, must overpower the other in its descent; and that, if by any means one of the vanes be turned a quarter of a revolution, it must at the same time carry with it the one which is connected on the opposite side of the nave; and this turning is effected by fixing with screws a block of wood, on the partition at K, in the form of a strong bracket. This block will not permit the ascending vane to pass it without being turned on its edge, by which means the one below is turned at the same time, to present its board surface to the large vane port. It may be necessary to remark that when the machine is to be set at work, the steam is not admitted into the upper apartment of the vessel, to exclude the air, but enters immediately from the valve box to the eduction or discharging pipe, in order to preserve the grease which is made use of to lubricate the internal moveable mechanism of the engine.

**To Kill Rats.**

The oil rhodium and oil of anise are sometimes used to attract rats. Professional rat catchers in England, employ these substances to entice rats to their traps. Dr. J. V. Smith, of Boston lately stated at one of the agricultural meetings, that he had tried annis alone and the rats came forward immediately, while he was present. He stated, also, that ground plaster of gypsum, mixed with dry meal, will be eaten by rats, and that it will set in the stomach and kill them.

The atmosphere is not a chemical but a mechanical mixture.