of quinine—that is to say, caused by a change of refrangibility in the ultra-violet rays.

Angstrom first threw out the idea of fluorescence being a property of certain gases in the atmosphere. To possess this property the gas must be capable of absorbing either in part or entirely the ultra-violet and violet rays, and of emitting them with a lowered refrangibility and without being polarized. Ozone possesses the property of absorption in the highest degree in the ultra-violet region, and I have now to announce that strongly ozonized oxygen is highly fluorescent when seen in a glass bottle two inches in diameter illuminated by an electric spark passing between cadmium electrodes. The color of the fluorescence is a beautiful steel blue. This fluorescence has not been observed in other gases, but it is in the highest degree probable that oxygen is fluorescent, though this has yet to be proved. There can be, however, little doubt that the color of the sky is caused in part by the fluorescence of ozone, and also to some extent by the transmission of rays through the blue gas. The blue of distance is doubtless to be attributed more to transmission than the blue of the sky, though it is quite conceivable that fluorescence also here comes into play. Whatever other cause concurs in the production of the blue of the heavens, it has certainly been established by M. Chappuis that the properties of ozone participate in its production.

In August, 1884, a very short note was sent by me to *Nature* concerning the red solar halo seen at Zermatt and on the Riffelberg with great distinctness. I recorded the occurrence of a dark band in the spectrum, slightly more refrangible than D, which was seen to vary in intensity; a second band a little less refrangible than D was also observed. On account of the altitude at which the observations were made, viz., 9,000 feet, and the state of the weather at the time, these bands were considered to be due to some constituent of dry air.

The subject of the telluric rays has become of increased interest since M. Cornu has studied the dark lines in the neighborhood of D, but unfortunately the rays absorbed to which I refer are both a little more and a little less refrangible than those figured on his map of this region. If we accept the number 5,890 tenth-metres as approximately representing the mean value of the lines, D¹ D², the narrow bands observed by me have wave lengths about (1) 5,950 and (2) 5,770 at their darkest parts, as far as one can ascertain with a hand spectroscope giving excellent definition but small dispersion. They are very variable, being dependent on the state of the weather, and are more distinct and broader when viewed with the sun on the horizon. In London during the dry calm weather of June and July, 1884, they were very strong, but variable in different parts of the sky.

The less refrangible band, or broad line as it usually appears, below D, is generally overlapped by a band belonging to water vapor, the chief "rain band." On this account observations at an elevation of 10,000 feet or so during perfectly dry weather were considered of interest. The bands were observed against the blue sky on several occasions, but they were also at other times entirely absent or barely visible. There is some liability to a group of iron, barium, and other solar lines being mistaken for the more refrangible band when it is not decidedly strong. Chappuis observed bands in the blue sky coincident with ozone bands, and I have on that account always expected to find some indication of the spectrum of ozone in the upper atmosphere, but the reason why there must always be a difficulty in obtaining evidence of any absorption due to this substance arises from the strongest visible band of ozone, with wave length 6,095 to 5,935, being masked by the band of water vapor; and secondly, because the total amount of white light so preponderates as to overpower the effect of absorption—that is to say, the rays absorbed are only a small fraction of those transmitted, so that the bands are faint and the color due to absorption is either not seen or seen only with difficulty. Owing to this fact we cannot distinguish the blue color of the clouds when the sunlight is bright; but when the sky is completely overclouded with cumuli, a faintly bluish tint is given to the cloud shadows, even at the zenith. Near the horizon not only are the bright parts of the clouds blue, but their shadows have a rich blue tint.* The blueness varies somewhat; at times it may be seen to shift about in the sky; it has been observed, for instance, to pass over from southwest to northeast. The second but less conspicuous band of ozone absorbs rays with wave length 5,770 to 5,600. Both bands have been observed in a dry atmosphere at elevations varying from 6,000 to 10,000 feet, both in the blue of the sky and against white clouds. The measurements, very imperfectly made under difficulties, showed them to have wave lengths about (1) 5,950, (2) 5,770, in the center of the dark portion, while, according to Chappuis, the bands of ozone are:

(1) 6,095 to 5,935	mean, 6,010
(2) 5,770 to 5,600	mean, 5,680

On Angstrom's chart, a dark band, diminishing in depth toward the east, extends from 5,735 to 5,680, which is classed among the *raies atmospheriques*; this is similar to the band observed by me when viewing the sun or bright clouds near the horizon, and is similar to the second ozone band.

The work of Prof. Piazz-Smyth, "Madeira Spectroscopic," does not give that portion of the spectrum which would serve for comparison. The "low sun band," δ , comes very near to band (2), wave length 5,770, while the "rain band" comes very near (1), 6,095. On several subsequent occasions the two bands were observed at lower levels than Zermatt and the Riffel, but with even less intensity. On the last occasion (November 10, 1884) that such an observation was recorded, there was only a trace of these faintly seen. No doubt a clear atmosphere, free from the turbidity so easily created by condensing moisture, is essential to their visibility. Schoene has observed bands in a bright sky before sunrise and after sunset, during an intense frost in Central Russia. The measurements taken identified them with ozone bands, and leave scarcely any doubt whatever of the presence of ozone in the atmosphere; and if it can be so recognized, it must communicate its characteristic blue color to the air

(*Journ. Chem. Soc. Abstracts*, vol. xlviii., part 2, p. 713). The remarkable crepuscular phenomena seen at the close of 1883 proved highly favorable to such investigations.

In order to continue a series of observations on the solar spectrum near D, it would be best to employ a fairly good dispersion and large lenses with long focus admitting a large amount of light to the eye, or, better still, to specially prepared photographic plates highly sensitive to the yellow rays.

The very extensive absorption of the ultra-violet rays by oxygen leads us to expect it to be fluorescent. All such absorbents are fluorescent more or less, and generally strongly, but when the absorbed rays are of very short wave length, the fluorescence is not always visible. Thus there are many substances which do not appear fluorescent by lime light nor by dull daylight, but are strongly so when seen by electric light, especially if it has passed through no glass or other medium than a quartz lens and a short column of air. Some substances are not fluorescent when seen in glass vessels, because the glass has absorbed those rays of which the refrangibility would have been lowered by the fluorescent substance. In air, and by the light of an electric spark rich in ultra-violet rays, such as that from cadmium electrodes, almost everything is fluorescent. The whole range of the cadmium spectrum has been viewed by me, owing to the fluorescence of the purest white blotting paper. The light, of course, is feeble, and the eye has to be trained to make observations in total darkness.

Pure water, however, never appears fluorescent. Some solutions in water, which transmit all the ultra violet rays as far as 2,304, are fluorescent, though whether this is caused by impurities or not has not been decided.

It cannot any longer be doubted (1) that the extreme limit of the solar spectrum observed by Cornu is caused by the gases in the atmosphere, probably both by oxygen and ozone; (2) that the blue of the sky is a phenomenon caused by the fluorescence of the gaseous constituents of the atmosphere, and probably ozone and oxygen are the chief fluorescent substances; (3) that ozone is generally present in the air in sufficient quantity to render its characteristic absorption spectrum visible, and that therefore it gives a blue color to the atmosphere by absorption, through which blue medium we observe distant views; (4) that water vapor does not participate in the coloration of the atmosphere under like conditions and in the same manner as ozone.

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A SELECT METHOD OF PREPARING NITROGEN GAS.

By H. N. WARREN, Research Analyst.

THE formation of nitrogen gas when required as an agent, either for the lecture table or when in larger quantities for research, always presents more or less

difficulty as regards its preparation; one process, still recorded in the various hand-books of science, being the action of nitric acid on raw meat. This method may, however, without doubt be regarded as nothing more than an alchemical memoir, since it would be evidently difficult to state, or enumerate, the complicated mixture of other gases which becoming evolved at the same time would naturally contaminate the product. The action of potassium nitrite when heated in a suitable apparatus in admixture with ammonium chloride produces, when prepared cautiously, a moderately pure gas, but owing to the inconstancy of the reaction the same is rendered considerably tedious and unprofitable. As a third instance, the reaction that phosphorus affords when burnt in a limited supply of air, as, for instance, when confined by the aid of a bell jar and in direct contact with water, at once presents an elegant and at the same time uncouth method of preparing a very pure gas, and direct from the atmosphere. This, although a favorite method of most demonstrators and others when experimenting with or illustrating the component parts of the atmosphere, yet at the same time few, if any, seem to have adopted a plan to recover, or more correctly to collect, the so prepared gas, which by a slight alteration in the form of apparatus to that generally employed may be procured in any desired quantity.

The accompanying figure, which is intended to illustrate the apparatus required, consists mainly of a doubly tubulated gas receiver or bell jar connected either with a bladder provided with a suitable stop cock, or, if required in larger quantities, to an ordinary gas holder, the outer vessel containing a sufficiency of water to allow of the gas jar at the termination of the action to be immersed to the required height. In using the apparatus, all that is necessary is to apply a hot wire to the pieces of phosphorus contained in a small brass dish, the same being allowed to float upon the surface of the water. This is most readily accomplished by withdrawing the stopper from the side tubule, inserting a hot wire in order to start the combustion of the phosphorus, and replacing the stopper. The apparatus and its contents, after the combustion of the phosphorus has terminated, is allowed to remain a few moments in contact with the water in

order to allow the fumes of phosphoric pentoxide occasioned by the combustion of the phosphorus to unite with the water. The stop cock, in connection with the receiver intended for the reception of the gas, is now opened, the weight of the bell jar exerting a pressure sufficient to allow of its contents to be discharged into the receiver. The tap in connection with the receiver is next closed, the stopper from the side tubule again withdrawn, thus allowing, on raising the apparatus to the surface of the water, to admit of a fresh supply of air, which may be proceeded with as before. By this method, operating with a jar capable of retaining one cubic foot of atmosphere, a gas holder able to contain six cubic feet of nitrogen may be filled in less than an hour.—*Chem. News*.

AN AUTOMATIC WASH BOTTLE.

By J. F. JONES.

THE figure represents a section through the flask, and its fittings, which are just the same as those of an

ordinary wash bottle, with the exception of two valves. One of these is placed at the end of the air tube, *a*. It is a "Bunsen valve," which consists of a piece of rubber tubing, placed over the end of the glass tube. The lower end of the rubber tube is closed with a piece of glass rod. In this rubber tube there is a slit cut, which will allow air to pass into the flask, but will not allow it to pass out. The pressure of the air is thus increased in the flask, and an equilibrium can only be restored by water flowing out through the delivery tube. In order that this flow may be stopped when desired, the other valve is placed in. It consists of a glass tube, *c*, into which a small wooden rod is placed. At the lower end of the rod is a disk, which fits over the end of the glass tube, and to make it fit air tight, a rubber washer is placed at *d*. This disk is held tight against the tube by a small spiral spring, *e*. After blowing air in at *A*, and causing water to flow from the delivery tube, equilibrium can be at once restored, and the flow of water stopped, by simply pressing on the button, *f*. It is a very convenient piece of apparatus, as it saves the trouble of blowing during the whole time of washing a precipitate. By applying the mouth at *A* once, enough pressure can be obtained to keep the stream flowing for some time.

PRODUCING ALUMINUM AND OTHER METALS AND ALLOYS.

THIS invention relates to apparatus for producing, by electrolysis, aluminum and other metals from their refractory compounds. *B* is a series of carbon plates forming the positive pole, the negative pole being molten metal in a carbon crucible, *A*; *a* is an insulated box. The crucible is of carbon. Copper pins, *a'*, conduct the current to interior of crucible, *A*. The positive electrode, *B*, dips into crucible, *A*. *g* is a clamp for holding the plates, *b*, and by means of which the electrode can be raised or lowered. The crucible, *A*, has a cover, *k*, of refractory material, in which are formed openings, *n*, for charging the material to be treated, which also serve as outlet passages for the gases produced. Plates, *o*, each having a handle, *o'*, close the holes during the melting process. At the

commencement of the operation the electrode, *B*, is brought lightly in contact with the granulated copper in crucible, *A*, a current is passed through and melts the copper which serves as the negative electrode, upon which clay or alumina is placed in the crucible and electrode, *B*, somewhat raised. The current will then pass through the alumina and melt and decompose it into its constituent elements, oxygen and aluminum.

* Prof. Pickering has proved that sunlight as it reaches us is blue, which must be the case if it has passed through a blue medium (*Proc. American Academy of Sciences*, 1880, p. 236).