

Scientific American.

ESTABLISHED 1846.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT NO. 87 PARK ROW, NEW YORK.

O. D. MUNN.

A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included. \$3 20
One copy, six months, postage included. 1 60

Club Rates.

Ten copies, one year, each \$2 70, postage included. \$27 00
Over ten copies, same rate each, postage included. 2 70

The postage is payable in advance by the publishers, and the subscriber then receives the paper free of charge.

NOTE.—Persons subscribing will please to give their full names, and Post Office and State address, plainly written. In case of changing residence state former address, as well as give the new one. No changes can be made unless the former address is given.

Scientific American Supplement.

A distinct paper from the SCIENTIFIC AMERICAN, but of the same size, and published simultaneously with the regular edition.

TERMS.

One year by mail. \$5 00
SCIENTIFIC AMERICAN AND SUPPLEMENT, to one address. 7 00

Single Copies. 10
The safest way to remit is by draft, postal order, or registered letter.

Address MUNN & Co., 87 Park Row, N. Y.

Subscriptions received and single copies of either paper sold by all the news agents.

VOLUME XXXV., No. 10. [NEW SERIES.] Thirty-first Year.

NEW YORK, SATURDAY, SEPTEMBER 2, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

Table listing various articles such as 'Acre, dimensions of an...', 'Albatross, the...', 'Answers to correspondents...', 'Blood, photographs of...', 'Boat-lowering apparatus...', 'Breeding cattle, etc.', 'Bridges, Ear River, the cables...', 'Bridge, new, at Pittsburgh, Pa.', 'Business and personal.', 'Centennial, Cornell at the...', 'Door knob, improved', 'Dredging machinery, new', 'Dryers for cotton seed oil', 'Dyes from hair, etc.', 'Dynamo-electric machine', 'Earthquakes', 'Exhibition, the Philadelphia', 'Facts and formulae', 'Failures, what they teach', 'Feathers, purifying', 'Fire arms, breech-loading', 'Gold, volatilized', 'Gravitation, the laws of', 'Horses, hiring', 'Hydrophobia (3)', 'Ice boats, etc.', 'Inventions patented in England', 'Inventors, opportunity for', 'Lighthouse illumination', 'Lighting conductors'.

THE SCIENTIFIC AMERICAN SUPPLEMENT.

Vol. II., No. 36.

For the Week ending September 2, 1876.

TABLE OF CONTENTS.

Table listing contents of the supplement including: 'I. THE INTERNATIONAL EXHIBITION OF 1876, with 10 engravings...', 'II. ENGINEERING AND MECHANICS...', 'III. TECHNOLOGY, ETC. With 12 illustrations...', 'IV. LESSONS IN MECHANICAL DRAWING...', 'V. CHEMISTRY AND METALLURGY...', 'VI. ELECTRICITY, MAGNETISM, LIGHT, HEAT, ETC.', 'VII. NATURAL HISTORY, ETC.', 'VIII. MISCELLANEOUS...'.

The Scientific American Supplement

is a distinctive publication issued weekly; every number contains 16 octavo pages, with handsome cover, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, \$5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all news dealers throughout the country.

COMBINED RATES.—The SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT will be sent together for one year, postage free to subscribers, on receipt of \$7.00.

TO SCIENTIFIC AMERICAN SUBSCRIBERS WHO WISH TO TAKE THE SUPPLEMENT.—A subscriber to the SCIENTIFIC AMERICAN may change at any time to the SUPPLEMENT, or may have both papers sent to him, by remitting to us the difference between the amount already paid for the SCIENTIFIC AMERICAN and the SUPPLEMENT prices above mentioned. Remit by postal order. Address

MUNN & CO., PUBLISHERS,

87 Park Row, New York.

All the numbers of the SUPPLEMENT from its commencement, January 1, 1876, can be supplied; subscriptions date with No. 1 unless otherwise ordered.

Single copies of any desired number of the SUPPLEMENT sent to any address on receipt of 10 cents.

THE MOON'S ATMOSPHERE.

The moon has no atmosphere, the text books tell us: or if any, it is comparable in density only to the best vacuum to be obtained in the receiver of an air pump. Bessel estimated the greatest surface density possible in a lunar atmosphere, consistent with lunar phenomena, to be the thousandth part of that of the earth's atmosphere; and most writers on astronomy have accepted his conclusion as final.

But it has been found that the calculations which led Bessel to this result were vitiated by serious errors and omissions. He failed in the first instance to take account of the difference in the force of gravity on the moon and on the earth. Allowance being made for that, it appears that the surface density of the moon's atmosphere may be three times what Bessel made it. He also overlooked the influence of temperature. Making the necessary correction for this element, his equation shows that, so far from being limited to a density a thousand times less than that of the earth's atmosphere, the moon's atmosphere may be five times as dense, or one two-hundredth that of our air. In view of the diminutive mass of the moon and the feeble action of gravity upon its surface, such an atmosphere would be relatively quite as important, quite as effective in its influence on the surface, as the earth's atmosphere is.

Taking the earth as unity, the diameter of the moon is less than two sevenths; its surface area, one thirteenth; its volume, one forty-ninth; its mass, a little more than one eightieth; its mean density about three fifths; and the force of gravity on its surface rather less than one sixth.

Spread over a surface relatively so much greater than the earth's (as 1/3 to 1/1) and acted on so slightly by gravity, the moon's atmospheric envelope—assuming it to have been proportionately as ample as the earth's at first, and the conditions to have remained similar—would necessarily occupy a very much greater comparative volume than the earth's atmosphere, while its surface density would be not more than one fiftieth part as great.

But this maximum density possible under Bessel's estimates must greatly exceed the density actually possible at the present time, since the absorption of the moon's atmosphere by the moon's surface must have gone on much more rapidly than the corresponding absorption by the earth, the surface exposed being relatively six times greater.

Think what enormous volumes of carbonic acid gas, oxygen, hydrogen, and so on, have been withdrawn from the earth's atmosphere, to enter into solid combination in the coals, limestones, granites, and minerals of every sort; and try to realize what the condition of atmosphere would have been had it been subjected to the absorbing action of a similar surface six times more extensive. Such, relatively, have been the conditions prevailing in the moon. If correspondingly reduced, its atmospheric envelope is not likely now to have surface density more than one three hundredth part of that of the earth's atmosphere.

The question therefore is whether astronomers have been able to detect positive evidence of a lunar atmosphere, not like the earth's, which we have no reason to expect, but of such a density as may reasonably be considered possible there.

In his recent able and authoritative treatise on the moon, Neison remarks that all astronomers who have devoted much time and attention to the detailed examination of the lunar surface have recognized more or less direct indications of a rare lunar atmosphere, besides the more indirect evidence afforded by the known conditions of the moon's surface and the phenomena presented by it. Again, with reference to Bessel's estimate of its density, he says: "But this opinion was coincided in by none of those astronomers to whom is due our knowledge of the condition of the moon, and they recognized that the lunar atmosphere seemed to possess a greater density than the theoretical considerations would appear to permit."

We have seen that those theoretical considerations rightly interpreted, are in accordance with the existence of a lunar atmosphere, very far from being insignificant; and it is simply to examine the evidence borne by observable phenomena.

The only methods sufficiently delicate to detect unmistakably a lunar atmosphere, having a surface density less than one hundredth that of the earth's, are those based on the refraction of a ray of light traversing it; and of these the most trustworthy is that based on the observed times of lunar occultations, that is, the cutting off the light of a star by the moon coming between us and it. If the moon had no atmosphere, the disappearance of the star should coincide exactly with the calculated time. With an atmosphere of appreciable density, the disappearance of the star must be delayed by refraction. The difference between the observed and the calculated time of an occultation would, therefore, furnish a measure of the density of the lunar atmosphere, provided the calculated time were minutely exact.

Unfortunately this requires the moon's diameter to be exactly known, but that is still doubtful within very small limits, owing to the disturbing effect of irradiation. As the result of some hundreds of recent observations with powerful instruments, however, occultations appear to be retarded from five to ten seconds more than can be accounted for by the effects of irradiation. Consequently the existence of a lunar atmosphere sufficiently dense to produce the difference found is not only possible, but very probable, considering the consistent nature of the results obtained by observations and the apparent inadequacy of other causes to explain them. The maximum surface density of the moon's atmosphere, according to these conditions, is about one two-hundredth of that of the earth; but this re-

sult must be considered as merely probable, the exact density being unobtainable with the observations at present existing, owing, as already noticed, to the uncertainty as to the moon's exact diameter.

Among the appearances which are regarded by students of the moon's phenomena as proofs positive of a lunar atmosphere of considerable density, we may mention the twilight at the cusps of the moon, the dimness and obscurity observed at times in certain localities while surrounding objects stand out sharp and clear, the blue, transient fringe to crater walls at sunrise, the local and quickly disappearing gray border to the black shadow of some of the deep crater formations, the misty appearances within deep craters at sunrise, and the blotting-out of surface details by mists which vanish as the sun rises.

After reviewing at length the evidence of these and other lunar phenomena, Neison decides that the existence of an atmosphere to the moon must be regarded as certain; the only uncertainty that remains is with respect to its density, which he is persuaded must in all probability lie between three and four hundredths of that of the earth's atmosphere. It "is therefore capable of exerting almost as powerful an effect upon the surface as the earth's, and, proportionately to the mass of the moon, is not much inferior in amount."

THE RECENT WORKING MEN'S DEMONSTRATIONS.

In this city, in Philadelphia, in Newark, and in many other of the large populous centers, the abnormal spectacle is now being witnessed of working men banding together and marching in procession to demand of the authorities an opportunity to earn an honest living. It is impossible not to feel the greatest commiseration and concern for men reduced to this predicament, and it would be uncharitable not to find in the circumstance every condonation for errors of judgment. We are well aware that it is like offering stones, when bread is asked, to answer appeals for immediate help by indisputable maxims of political economy; but on the other hand, the working men have nothing to gain by closing their eyes to the truth, however distasteful or unfortunate the same may be, and there is something still to lose by their pursuing a course which can in no wise ensure to their benefit.

A moment's consideration must show to every intelligent workman that his is in reality neither an especially oppressed nor yet a privileged class of society. If he will remember that the terrible financial stress of the last three years has affected everyone, that great business houses, believed to be superior to all possible vicissitudes of fortune, have been utterly annihilated, great enterprises, apparently in the full tide of success, have been arrested, that we have experienced not a sudden panic, from which recovery was possible, but a slow yet inevitable shrinkage of value in all things, he will perceive that by no combination of circumstances could he and his fellow laborers be made an exception to the general misfortune. When employers barely have the means to keep their business in existence, and then are thankful that their affairs are no worse, when, as must be the case, every penny is considered more closely than dollars were before, when people cannot hire men to do work, simply because they have neither the money to pay for it nor any way of disposing of the results of labor, it certainly cannot be expected that work can go on. Nor is there any sudden and rapid method of forcing the same into existence.

There is no greater mistake than to suppose that government can do this. The governing power is not paternal here, as in France or Russia. No one would more quickly resent its interference with his private affairs than would the working citizen himself. The particular persons whom we call President, or Mayor, or Governor, or Aldermen, who manage, for brief periods, the mechanical proceeding incident to government, are but paid servants of the public, not rulers and for the workingmen or any other class of sovereign citizens to ask, of those whom they hire to do certain work, an exercise of power without the duties and powers which they themselves have strictly defined and limited by law is not sensible.

Again, it would not be just that one part of the population, because it earns a living by daily physical labor, should be provided for to the exclusion of every other class. The employer who may be laboring at his desk until his bodily powers threaten to succumb, in order to avert impending ruin, has an equal right to assistance. The butcher, the grocer, all the retail trades' people, who are dependent on the working man's custom for their living, would be equally justified in asking help because the working men now buy less of their commodities. It is clear that, if the State had power to make work, that work would have to be paid for by the people, through taxation; and when the working man came to spend his earnings, he would find that they would buy just so much less meat and coal in proportion as the dealers, through their increased taxation, have been compelled to raise the prices.

It seems to us that the only sensible course at hand is for the men to bear their misfortunes patiently, to be vigilant; and when any honest labor, no matter what, does appear, to take it and be content with any wages that will afford support. We say plainly that the present is no time for strikes such as the longshoremen and stone cutters have been making, no matter what the pretext, and that the period is still less propitious for enforcing dicta of trade societies or the unwritten laws of trade etiquette. We believe there is a deep-felt sympathy for the working men pervading the community, and that there is a growing tendency to afford employment whenever it can possibly be done. It remains for the men who join in processions and other demonstrations to see to it that no hasty or ill advised action, on their part, impairs this favourable public sentiment.