

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. 17. [NEW SERIES.] Thirty-first Year.

NEW YORK, SATURDAY, OCTOBER 21, 1876.

Contents.

(Illustrated articles are marked with an asterisk.)

Answers to correspondents. 268
Ball puzzle, the*. 262
Battery difficulty, a (10). 268

THE SCIENTIFIC AMERICAN SUPPLEMENT.

Vol. II., No. 43.

For the Week ending October 21, 1876.

TABLE OF CONTENTS.

I. THE INTERNATIONAL EXHIBITION OF 1876. With 15 figures.—
II. ENGINEERING AND MECHANICS. With 32 figures.—
III. TECHNOLOGY, with 36 figures.—
IV. LESSONS IN MECHANICAL DRAWING, by Professor MACCORD, with 10 engravings.

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.

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.

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

PROFESSOR HUXLEY'S MISTAKE.

It now appears that Professor Huxley made a grave mistake in giving such prominence to the Miltonic hypothesis of creation in his Chickering Hall lectures.

To say the least, it was a sheer waste of time and effort, and many aver that it was something a good deal worse: indeed, that he might just as appropriately have spent the time arguing that the moon is not made of green cheese, or that the world is not flat, or in discussing any other childish or antiquated notion, since not one of his audience ever dreamed of entertaining Milton's absurd six-day theory, which every American school boy knows to be inconsistent with the commonest facts of geology.

It looks that way, we must confess; still we cannot bring ourselves to believe that Professor Huxley really intended to insult us. At the worst, it was a mistake, grievous, to be sure, but unintentional: a result, doubtless, of what certain of the daily papers have so pertinently described as "Professor Huxley's habit of generalizing from insufficient data."

We have just been looking over a considerable pile of the religious papers of last week, to see their comments on the lectures, and we are sure that Professor Huxley would be surprised to witness how generally and how vigorously they repudiate the Miltonic hypothesis. Now and then a belated sheet stands up for it, figuratively speaking; but the majority stoutly put it aside with scorn, and profess that evolution—or, as the favorite phrase runs, "a modified form of evolution"—is not only perfectly reasonable and scriptural, but a theory which they have cherished for years and years!

For example, the broadly undenominational Christian Union, speaking of the present order of Nature, remarks: "If Mr. Huxley's object was to illustrate the truth that evolution has performed an important part in producing that order, he has admirably succeeded. But that is a truth which no well informed person in America doubts. The mythical Pennsylvania Dutchman, who still votes for Andrew Jackson and believes that the sun goes round the world, probably supposes that the Universe was created in a week beginning on a Monday morning, January 1, 6,000 B. C. . . . But no one of the exceptionally intelligent audience which listened to Professor Huxley's arguments, and few, if any, who read them, entertain the Miltonian theory of creation."

Here we have not only a positive rebuttal of Professor Huxley's insinuation, but one carrying beautiful internal evidence of its truth. The writer—doubtless one of the younger members of the Christian Union staff—so far from holding that anciently exploded theory, has never learned (or has forgotten) that, according to it, the proper date of creation is, or used to be, not the year 6,000 B. C., but B. C. 4,004!

But, it may be objected, the Christian Union is Mr. Beecher's paper; and Mr. Beecher has always been regarded by the strictly orthodox as a trifle unsound on some points. Well, then, take the intensely evangelical Christian at Work, whose vivacious editor, the Rev. T. De Witt Talmage, as everybody knows, is nothing if not sound. The Christian at Work reprovingly assures Professor Huxley that "it was not at all necessary for him to cross the ocean to demolish a poet's fancies about creation—theories largely imaginative and not consistent with the record in Genesis, and which neither are nor have been held for a century."

That is certainly decisive, though, like most of Mr. Talmage's utterances, it is a little loose in the joints and a trifle extravagant. Our recollection does not cover nearly a century, yet we distinctly remember having been taught precisely that account of creation, order, time, and all, while at school: and to make sure, we have taken pains to hunt up the remains of our old school geographies and histories, wherein we find the Miltonian story set down with great explicitness. We would not presume to say, however, that such absurdities have been imposed upon credulous children of late years.

One more witness against Professor Huxley is all we have space for, and one will suffice. As the evangelical side of the Protestant community has been fully repre-

sented, we will take this time a representative of the other, or non-evangelical, side, the Church Journal and Gospel Messenger. This excellent paper grieves bitterly over Professor Huxley's unfairness in giving his hearers to understand that the Miltonian theory is generally received among Christians at the present day. On the contrary, "the position he attacks is not the educated Christian's position at all. And Dr. Huxley very well knows it."

It may be so: yet charity to the absent compels us to presume that Professor Huxley was ignorant rather than malicious or purposely unfair. Evidently he did not know how rapid has been the progress of sound knowledge on this point among our people. It is truly humiliating, none the less, to think that he could have spent so many weeks among us, and go away at last laboring under such a grave misjudgment of our intelligence. We fear his associations here were hardly what they ought to have been.

Since writing the foregoing, we have been thinking the matter over, and it has occurred to us that, may be, this mistake of Professor Huxley's—annoying as it has been to the moment to us, and must be sooner or later to him—may after all be useful in calling out a general expression of opinion, and so serving to emphasize, as nothing else could, the progress we have been making toward juster views of the origin of things. We believe it was Agassiz who first observed that all great truths have to go through the same course of treatment on the way to popular acceptance. First, they are denounced as false and subversive of religion. Next, they are admitted to be probable, but not proved, and of little account either way. Finally, they are just what everybody has always believed. Evolution, it would seem, has pretty nearly arrived at the final stage.

THE ADVANTAGES OF CHEAP PATENTS.

After paying a high tribute to American Science and Art in his address, as President of the Mathematical and Physical Section of the British Association, Sir William Thomson said, speaking of the Centennial:

"I was much struck with the prevalence of patented inventions in the Exhibition; it seemed to me that every good thing deserving a patent was patented. I asked one inventor of a very good invention: 'Why don't you patent it in England?' He answered: 'The conditions in England are too onerous.'"

"We are certainly far behind America's wisdom in this respect," Sir William continued. "If Europe does not amend its patent laws (England in the opposite direction to that proposed in the bills before the last two sessions of Parliament), America will speedily become the nursery of useful inventions for the world."

Sir William Thomson is a clever inventor as well as an able mathematician and scientist. His apparatus for deep sea sounding with pianoforte wire, for example, has given immense help to that sort of investigation, and promises to be of not less advantage to commerce generally. And it was his galvanometer, we believe, which enabled the electricians to demonstrate, at Hallett's Point, the perfection of the battery connections intended for the instantaneous firing of the enormous mass of explosives distributed throughout the great mine: an experiment even more impressive, when rightly understood, than the final blast. As an inventor, he appreciates the importance of encouraging inventors; as a patentee, he knows that the protection which a patent gives an inventor is at once the cheapest and the most effective encouragement that his country can offer him.

America is, or is rapidly becoming, the nursery of useful inventions for the world, not because we are by nature more inventive than other men—every nationality becomes inventive the moment it comes under our laws—but simply because the poorest man here can patent his devices. And it does not matter how simple the contrivance may be, provided it is new.

In the aggregate the little things—which in England or on the continent either could not be or would not be patented, owing to the excessive cost of the papers or other onerous conditions—probably add more to the wealth and wellbeing of the community, and more to the personal income of the inventors, than the great things do. And very frequently the profit derived from some simple contrivance gives an inventor the independent time and the money required for the development of inventions which he could not otherwise dream of undertaking.

A striking illustration is furnished by the experience of the inventor of what is generally admitted to be the greatest advance made for many years in the art of weaving, the Lyall loom. During the war he invented and patented a simple compound for waterproofing textile fabrics. It was largely used, and brought him a generous revenue. We would not say that his valuable loom would not have been invented except for the fortune which the previous invention brought him; but it is very doubtful if he would otherwise have had the means for completing the work, even if he had had the will to do it. Without the encouragement of low patent fees in the first place, it is altogether likely that he would never have become a practical inventor at all.

Another illustration of the very great importance of some little inventions is found in the galvanometer already alluded to. It saved the first Atlantic cable from being a complete and utter failure, and so demonstrated to the world the grand fact that submarine telegraphy through long distances was not chimerical: yet it consisted essentially of nothing more than a slender magnetic needle, three eighths of an inch long, carrying a circular mirror about a quarter of an inch in diameter, the whole—weighing a grain and a half—being suspended by a film of silk. Without this prompt and acutely sensitive little indicator of electric dis-

turbance, telegraphing through great lengths of submerged wire would have been practically impossible, owing to the length of time required for each signal wave: and it is not at all unlikely that, had Sir William's invention not been on hand in the nick of time, the Atlantic cable would not only have been abandoned as a hopeless failure, financially considered, but capitalists would have declined to sink any more money in that sort of enterprise. But its usefulness did not end there; it has since been and must ever continue to be of the utmost importance in ocean cabling, and in all important electrical operations on land, whether practical or purely investigative.

THE SPIRITUAL SLATE.

These are sorry days for spiritualists. Scarcely a week passes but some shining light in their troubled world is shattered, some "unimpeachable" instrument of the spirits and mediator between poor humanity and the angelic hosts is detected in vulgar trickery. And what is more discouraging, disaster seems ever to press hard upon delusive triumphs.

The latest misadventure is one of the saddest. Just when, by a clever trick, the subject had been sprung upon the British Association, and the champion performer and wonder worker of the sect, Dr. Slade, had been advertised beyond precedent, a mousing zoölogist plots with a friend of like character, and the result is

"One more triumph for devils and sorrow for angels,"

one more opportunity for the unbelieving to wag their heads, and cry—Next!

The story of Dr. Slade's experience in this country and in England is an interesting one; and as the English papers have lately been much occupied with his exploits, his downfall is more than ordinarily significant. Most of our readers have doubtless heard of his method, which is specially his own. He takes a slate—that is, he used to take a slate, and very likely still does the same, exposure being no bar to confidence on the part of the faithful—he takes a slate, wipes it clean, puts a bit of pencil on it, then places it under a table, on the questioner's head, behind his back, or elsewhere, and straightway a scratching sound is heard, and in due time a more or less clearly written message is produced: fee five dollars.

Everything appears to be frank, honest, and above-board, also very mysterious and altogether inexplicable, most observers declared, except on the hypothesis of "spirit" intervention. But there was one circumstance that the sceptical did not like the look of. It was a common thing for spiritualists to claim that they had known the spirits to write for Dr. Slade on the inside of a double slate when the two leaves were securely fastened together. But when an unbeliever offered such a test, the honest Doctor would candidly express his doubts of success; the conditions of the ordinary *séance* were exacting enough, he would say, and the intelligences which governed him would have nothing to do with locked slates, or the chemically prepared or otherwise doctored slates which too particular Yankees frequently brought him. Wary intelligences! and eke with tender sensibilities!

Nevertheless they have come to grief. One object of the paper read before the biological section of the British Association was to secure the appointment of a committee to investigate spiritualism with the hope to bring its vagaries under the protecting wings of Science. Particularly, the "phenomena" developed in the presence and through the ministrations of Dr. Slade were to be enquired into. The motion failed on account of the intolerance of certain bigoted scientists of the ungodly sort.

But the examination was made scientifically for all that—by Dr. E. Ray Lankester, F. R. S., and Professor of Zoölogy in University College, London, a gentleman well known to the reading public. Dr. Lankester visited Slade several times, and, like the venerable Dr. Carpenter, was "very much shaken" by what he saw. In fact he simulated considerable agitation and an ardent belief in the mysterious nature of what he saw and heard. All the time he studied Dr. Slade's performances closely, and at last he thought he saw through them. So he appointed another interview, and went for his friend Dr. Horatio B. Donkin, of Queen's College, Oxford, one of the physicians of Westminster Hospital, to whom he explained his hypothesis, and arranged for a demonstration of it next day.

The hypothesis was simply that Dr. Slade himself wrote the messages, which were of two sorts, one short and sprawling, the other long and with the characters well formed: the first Dr. Lankester believed were written with the finger of one hand as the slate was being held under the table, the second while the slate was resting on Dr. Slade's knee, concealed by the table, the operator being ostensibly engaged meantime in preparing the pencil for the "spirits" to write with, and so on. The test proposed was simply to seize the slate after it was cleaned and before it was put under the table—that is, at a time previous to its submission to the "spirits."

The thing was done, after two or three messages had been regularly received. With Dr. Slade's permission Dr. Lankester was to hold the slate under the table; instead, he accused Slade of having already written the expected reply, and on turning the slate over, found the charge sustained.

"To any one not predisposed to believe in spirit agency at all hazards," writes Dr. Donkin to the *London Times*, "this *séance* is sufficient." We have not the slightest notion, however, that Dr. Slade's standing among the mass of spiritualists will be affected in the least. It is said that, when the exposure was made, he simply remarked: "You see that you have been paid in your own coin: the spirits will not come

to people without faith;" and all true believers will accept the saying as not only satisfactory but grandly heroic.

Verily Faith, even more than Charity, hopeth all things, believeth all things, endureth all things!

THE INTER-MERCURIAL PLANET.

Quite a stir has recently occurred in the astronomical world, owing to the famous French astronomer M. Leverrier having telegraphed to the various observatories in Europe and America that it was probable that the supposed inter-Mercurial planet Vulcan would traverse the sun's disk in October. M. Leverrier at the same time requested that astronomers would watch most carefully for the phenomenon, and this, it is hardly necessary to add, has been done. The result, however, is disappointing, as the planet failed to appear, and the doubt as to its existence remains as strong as ever, although, on the other hand, the possibility of there being such another world is by no means unreasonable. It will be interesting, therefore, in the present connection, briefly to review the magnificent labors of M. Leverrier, as an incidental portion of which the hypothesis of a planet, nearer the sun than Mercury, suggested itself to his mind. And these labors have earned for the distinguished scientist the title of the "weigher of worlds," for all the great orbs which circle about the sun have been gaged by him as accurately as if they had been placed in the scale pan of some stupendous balance.

The vast work which we are about to sketch began on September 16, 1839; it was substantially completed on December 21, 1875; and the fact was announced by M. Leverrier in person, at the session of the French Academy at the last mentioned date. Every schoolboy knows that the sun is the central ruler of our planetary system, and that his mass is so enormously in excess of that of all the planets taken together that he is capable of swaying their motion without being himself disturbed. So colossal is the sun's attractive force that the like force which the planets exercise upon one another becomes extremely small. The sun's power over Saturn is 250 times that of Jupiter, even when the planets are nearest together; and as there is no disturbance in the whole solar system greater than that resulting from the mutual influence of Jupiter and Saturn, it is unnecessary to proceed further to show the paramount rule of sun. But small as these influences are, we cannot neglect them, for were the planets ruled absolutely by the sun they would go on circling in the same orbits, changelessly and for ever. Now if we consider that the more massive the planet is, the more potently it will disturb its neighbors, it follows that, even if we cannot tell exactly how much this disturbance amounts to, we can tell how large the planet's mass is, compared, say, with the earth's. Thus we can consider how much Venus disturbs Mercury, and thus infer her mass, and a chance comet may be affected by Venus, enough to afford us means for another determination. If our results over several observations failed to agree, we should search why; we should assume an error, which must be hunted down; and thus we should be led to one of two things, either to find our mistake, or else to discover some fact, before unsuspected, which has, unknown to us, become a factor in our problem.

This is Leverrier's method of dealing with planets, in a nutshell. Seven planets were known when he began his work; and finding that the tables of their motions in common use failed to rigorously accord with results of observation, he began the gigantic and complicated task of unraveling all the forces which produce the planetary movements. We can no more than summarize his results. Beginning with the earth, he reviewed nine thousand distinct observations of the sun; and by carefully estimating the sun's apparent monthly displacement, he reduced the accepted estimates of the distance of our luminary by between three and four million miles. Then he analyzed the observed motions of Uranus, and here he made the grand discovery of the unknown factor above referred to, which in this case could be none other than another great planet, producing the unaccountable Uranian perturbations. Concerning a hypothetical planet, he calculated its position; and aided by the lucky circumstance that but a very short time had elapsed since Uranus and the new planet were in conjunction, on pointing his telescope to the supposed position, he found Neptune. This magnificent result, shedding of itself enough glory on the astronomer to render him famous for ever, was, as we have seen, but incidental to the whole work, which has likewise included analyses of the motions of Mars, influenced by the great asteroid ring, and of Mercury, which has resulted in the noting of the remarkable perturbations, which are only to be accounted for by the existence of some inter-Mercurial matter, or probably by the existence of the supposed Vulcan. To the latter view, M. Leverrier, arguing very justly from the analogies of the discovery of Neptune, inclines, and therefore he is constantly on the alert for any visible indication of the hypothetical planet.

In 1859 M. Lescarbault, a physician in Paris, announced that he had witnessed the black disk of an unknown planet cross the sun. Leverrier at once investigated the details of the observations, and, despite the fact that the instruments used were of the roughest description, deemed the proof ad-duced conclusive that the planet had been seen: but Liais, an eminent Brazilian astronomer, subsequently reported that, at the reported time of transit, he likewise was examining the sun's face, with a very superior instrument, and that no black spot was visible.

There are few other recorded instances up to the present time where Vulcan is claimed to have been seen. On August 28 last, M. Leverrier communicated to the French Academy of Sciences, a letter from M. Wolf, a well known Swiss astrono-

mer, in which Wolf said that Weber in Prussia had seen a black spot crossing the sun on April 4, last. On the following day, Wolf, Schmidt (an astronomer in Athens, Greece), and Weber had all examined the solar disk, and no spot was then visible. Weber, unfortunately, did not note the rate of progression of the spot, nor has any one yet been able to find a solar photograph made at any observatory on April 4, so that there is no primary and positive evidence that the phenomenon was Vulcanian. On the other hand, there is secondary evidence to the effect that the spot disappeared within twenty-four hours, and that the period when it was seen would be that of the 148th transit, dating from the observation of Lescarbault, the Vulcanian year being 42.2 days. This, M. Leverrier deemed sufficiently important to warrant his making the general request noted in the first paragraph of this article. The result being as stated, the question still remains open, with the probabilities in favor of the halo of meteoric matter which is constantly about the sun being the cause of the Mercurial vagaries.

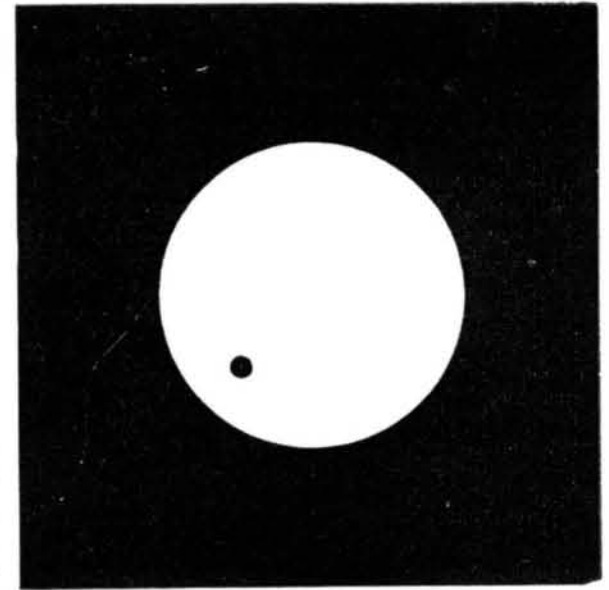
In this connection, however, the annexed letter of a correspondent details a phenomenon which is certainly worth considering.

To the Editor of the Scientific American:

The interest excited by the recent searches of the astronomers, for the supposed planet Vulcan, leads me to report to you the following observations made at Montclair, N. J.

On Sunday, July 23, 1876, at 3 P. M., I directed my telescope (2½ inch) towards the sun's disk in search of spots. As none had been seen for a considerable time previous, I rather congratulated myself on having at last found one, and on getting my instrument carefully focussed, was surprised to notice that, instead of the irregular, jagged form of common sun spots, this one was round.

It stood out on the lower left portion of the bright luminary, clear and sharp, as seen in the accompanying drawing.



Thinking that what I saw might be due to a defect in the lenses, I first rotated them in their tubes; but the round spot still kept the same place on the sun's disk. I then removed my object glasses, examined and cleaned them carefully. I did the same with my eyepiece lenses. On restoring them to their places in the tube, the same round body was still in view on the sun's disk. I called a friend to examine it with me. We studied it for some little time, until the clouds put an end to further observations. We concluded that we had chanced to hit upon a new kind of sun spot, perfectly round and black. We made no attempt to determine the motion of the spot.

A few days thereafter, on renewing my examination of the luminary, no spots were visible.

New York, October 4, 1876.

It will be perceived that the date of this observation is prior to the time when Weber's report was first brought to M. Leverrier's knowledge; and hence our correspondent had none of the present excitement to influence his imagination. Nor could the phenomenon have been due to a spot, for, as is well known, this is the minimum period of solar eruptions, and the sun's face has been spotless for many months; besides, spots never appear as black dots, but have clearly marked and unmistakable characteristics.

It appears further that M. Leverrier did not definitely designate October 2 and 3 as the epoch when the transit might occur. In his communication to Professor Watson of Ann Arbor, he specified October 9 and 10. Now M. Leverrier cites with details some thirty observations made by astronomers since 1750, and he selects data obtained in 1820 and 1856, and combines them with the recent results of Weber's observation. This leads him to conclude that the Vulcanian year is not 42.2 days, but 28.00774 days, and the motion of the planet is expressed thus: $V = 15.2^\circ + 12.85359^\circ (j - 1750)$ in which the first term is the longitude and j represents the number of days elapsed since 1750. The orbit is circular, the ascending node being at $+12^\circ$, and the descending node at 195° . M. Leverrier now thinks that the transit will be visible on October 30. This date does not coincide with an even number of Vulcanian years of 28 days since our correspondent's observation. There is a discrepancy of two weeks; but on the other hand, there is an equal failure of coincidence with Weber's date, April 4.

Since writing the above, we have learned that still another astronomer is to be added to the list of those who have seen Vulcan. Rev. E. R. Craven, of Newark, states that the late Professor Joseph S. Hubbard repeatedly assured him that he had observed the transit of an inter-Mercurial planet. He was at New Haven at the time, and was using the Yale College telescope. The transit was an entire surprise, and hence no notes were taken.