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### INVENTIONS WANTED IN INDIA.

The present industrial requirements of India is the subject of a very interesting communication received from an esteemed correspondent in Calcutta, whose position as proprietor of a large tea estate has given him an excellent opportunity for observation. His suggestions will be of interest to American inventors, as they point out new fields for the application of that ingenuity which has already given to American inventions such an enviable pre-eminence in the markets of both hemispheres. After a long period of apparent mechanical inertia, India is now evincing a progressiveness which will make her a country whose acquaintance it will be very desirable to cultivate. As her resources are still largely agricultural, one of the first demands is for improved farming tools and appliances. In tea culture, improved machines for rolling the leaf after withering, for firing, sorting, and sifting, are in demand, and would be heartily welcomed by many planters. In handling silk, a great disadvantage is at present experienced from the difficulty of producing an even thread. The fiber of the native silk is excellent, but the manipulations which it subsequently undergoes are so imperfectly performed that the product comes out an inferior article. India, it will be remembered, is the old home of the sugar cane, and improved crushing machinery finds ready market. One firm alone makes over a hundred thousand dollars annually in royalties from its patent mill. The indigo industry has been brought to considerable perfection, though there is still room for improvement in the chemical and mechanical manipulations. In addition, there are large amounts of crude products, such as oil seeds, jute, and cotton, which are exported, but which could be worked up at home to good advantage were suitable manufacturing processes available.

As all of these industries require large quantities of worked timber for boxes, buildings, carts, tool mountings, etc., there is an excellent market, our correspondent adds, for woodworking machinery. In many parts of the empire there are valuable forests, but the lack of sawmills prevents them from being utilized. The demand is particularly for portable machines which can be conveniently moved from place to place as demand and timber supply require. The mining implements of India are still very primitive, though the development of the petroleum industry has created a demand for improved boring tools. Steam launches and barges are coming into more general use, and considerable progress is shown in this direction. The railways have effected a marked mechanical advance. They now manufacture their own locomotives and most other appliances for railway service. We might enumerate many other departments from our correspondent's lengthy and carefully compiled notes in which this spirit of progressiveness is manifest, but we have probably said enough to convince American inventors that there is already a field in India in which to extend the success achieved at home, and it is a field the importance of which is annually increasing. Our correspondent thinks our manufacturers, exporters, and inventors will be unwise if they overlook India in their pursuit of new avenues for the distribution of their merchandise and the introduction of useful machinery and patent appliances.

The patent laws of India are liberal toward the inventor, and protection is as readily accorded there as in other countries; and with steam communication between England and India as regular as the boats ply between New York and Fall River, to which add the telegraph, India is no longer an "out of the world, barbarian country."

### THE AMERICAN MUSEUM OF NATURAL HISTORY.

We want to call the special attention of our readers to Mr. Gratacap's very interesting description in the SCIENTIFIC AMERICAN of April 17 of the more prominent specimens to be found in the paleontological department of the American Museum of Natural History at Central Park, New York. We believe that the institution is not as fully appreciated and used as it should be, because it is not very well known to the public.

We are sure that a great many more people would avail themselves of its treasures if they only knew how much there is there to claim their interest. And a word in regard to our illustrations. We have, it is true, built up an ideal picture in order to present more vividly those extinct organisms which once inhabited the land and sea, but our artist has not drawn upon his imagination for even the slightest detail. Both fauna and flora are exact reproductions of the actual specimens, just as the hand of Nature inclosed them between the limestone and sandstone pages of her great geological history.

The Museum is located on Eighth Avenue, at the corner of Seventy-seventh Street, on the west side of the Park, and is easily reached by way of the Sixth Avenue elevated railroad. It is open for free inspection, and contains so much of interest in its collections of minerals, fossils, natural history specimens, native woods, etc., that we are confident any and all of our readers, whether particularly scientific or not, must feel well repaid for the trouble of a visit by the pleasure of a careful examination. We hope that the educational importance of the collection will in the future be better understood and appreciated.

### NATIONAL ACADEMY OF SCIENCES.—ANNUAL MEETING AT WASHINGTON.

The regular annual meeting of the National Academy of Sciences was held at the Smithsonian Institution, April 20 and for several subsequent days, President O. C. Marsh in the chair. (See portrait on another page.)

The attendance of members was the largest ever known in the history of the Academy, including the following: Cleveland Abbe, Spencer F. Baird, George F. Barker, A. Graham Bell, John S. Billings, W. K. Brooks, John H. C. Coffin, Edward D. Cope, Clarence E. Dutton, William Ferril, Grove K. Gilbert, Theodore N. Gill, Arnold Hague, Asaph Hall, Julius E. Hilgard, George W. Hill, T. Sterry Hunt, Samuel P. Langley, Alfred M. Mayer, Montgomery C. Meigs, Henry Mitchell, S. Weir Mitchell, Edward S. Morse, Simon Newcomb, H. A. Newton, A. S. Packard, John W. Powell, Raphael Pumpelly, Ira Remsen, Ogden N. Rood, Henry A. Rowland, Charles A. Schott, Samuel H. Scudder, William Sellers, Sidney I. Smith, Arthur W. Wright, and Charles A. Young.

The session was especially signalized by the conferring of the first medal ever awarded by the Academy—the Henry Draper gold medal, of the value of $200, placed at the disposal of the Academy by the widow of the late Henry Draper, and awarded by a committee of the Academy for the best original researches in astronomical physics.

The award was not restricted to the limits of the Academy, but was to go to the most successful discoverer in all the world. After careful consideration, the committee reported that it was best deserved by a fellow member, Prof. Samuel P. Langley, of the Allegheny Observatory, for his researches into the wave lengths of light in the infra-red and ultra-violet portions of the spectrum.

In presenting the medal, President Marsh gave a synopsis of Prof. Langley's scientific researches, extending over the last fifteen years. In 1869 he observed the solar eclipse, and again in 1870, going to Spain the latter year. In 1875 he demonstrated the absorption of violet rays by the sun's atmosphere. In 1876 he studied the distribution of heat on the sun, and the limits within which sun spots affect climate, proving that they cannot make a difference of 1° Fah., and continued investigations of solar heat and its effect upon the earth for several years following. In 1878 he investigated the solar spectrum from Pike's Peak, and showed that the rays of the "great group A" were double. In 1881 he carried out the expedition to Mount Whitney, and ascertained that the amount of the sun's heat had previously been greatly underestimated. He increased the estimate 50 per cent. He also determined the fact that the sun is blue, and that the white light which we see is only the remnant sifted out by the selective action of the sun's and the earth's atmosphere. In 1882 he invented the bolometer, which enabled him to study with a degree of precision not theretofore attainable the undulations of long wave lengths below the visible red end of the spectrum. In 1884 and 1885 he applied this instrument to the study of terrestrial absorption and of the radiation of heat from the moon.

In 1885 and 1886 he prosecuted researches far into the infra-red region of the spectrum, discovering in terrestrial and lunar radiations undulations much slower than have been detected in the spectrum of light direct from the sun. Sir Isaac Newton had only succeeded in detecting waves of 0·00004 to 0·00007 millimeter in length, and in the two centuries since his time subsequent observers were able to extend the investigation only to 0·00010 m.; whereas, since the invention of the bolometer in 1882, Langley has demonstrated undulations of the length of 0·004 m., being a range forty times as great as all other investigators had covered in the two centuries preceding.

Two other medals of the same value are to be hereafter awarded by the Academy—the Watson medal, for original research in another department of astronomy, and the Lawrence Smith medal, for original discovery in meteoric bodies. The Watson medal has been awarded to Professor B. A. Gould, and will be conferred next year. The brilliant and instructive studies of Professor Hubert A. Newton, of Yale College, point to him as evidently the most conspicuous candidate for the honor of the latter medal.

The papers read at this meeting have been of high value, both scientific and utilitarian. Professor Langley presented results of his studies on invisible spectra. He said that most of the region of the spectrum from which energy comes to us is unknown. We have in the ultra-violet rays one hundredth part the amount of energy which comes from all the rest of the spectrum, and our investigations therefore have merely touched this region. This is due to the fact that these rays will not pass through glass, and rock salt, the most available medium, is difficult to work.

He has succeeded, however, in obtaining prisms of this material whereby to investigate the subject of the molecular vibrations associated with wave lengths.

Sir Isaac Newton determined wave lengths of 0·00003 to 0·00007 millimeter. In 1882, all that was certain was wave lengths of 0·00010 m.; within two years we went down to 0·00027 m. There we found that the sun's effect ceased.

Much greater results were subsequently obtained by the use of Rowland's gratings, being made of extraordinary size for this purpose. The apparatus was described in detail. It was of such delicacy that readings could be made down to 0·1 m. when there was one vibration in 40 seconds. The sodium lines were taken as fixed points of comparison.

The difficulty of manipulation was indicated by the statement that the spectrum to be examined must be identified and distinguished from among twenty or more other visible and an almost infinite number of invisible spectra.

The delicacy of the apparatus employed was such that the presence of a current of only 0 000000001 ampere was distinguishable.

Two years of work were required to overcome difficulties. The extrapolation formulæ employed led to cubic equations difficult to solve.

By means of numerous experiments, however, it was ascertained that the relation of the index of refraction to the molecular wave length of vibration throughout the entire spectrum is nearly represented by a hyperbola.

As a result, the shortest wave length measured was about 53,000 on Angstrom's scale. The longest wave length of the visible spectrum is about 0·01 m. The extremes found by Langley were 0·1 m. and 0·0025 m.

The shortest wave length of sound determined by Helmholtz is about 5 m., being only fifty times the length of Langley's longest wave length of the spectrum, thus vastly reducing the hitherto immeasurable gulf between light and heat on one hand and sound on the other.

Professor H. A. Newton read an important paper on Biela's comet, which is connected with the November meteoric shower. This shower was mostly over before sunset in this country, but in Europe it was notably brilliant, exceeding the display of 1872, though not equal to that of 1833.

In many places, up to a hundred a minute were counted by a single person, the maximum display continuing not more than three hours. Experiments show that no single observer can detect more than one-eighth of the entire number that fall; so that the shower probably amounted to 75,000 per hour.

To compute the density of their distribution in space, we must take into account the fact that we do not see them near the horizon as we should if we saw all that fall. One in fifty of all that are visible come within 10° of the zenith.

Computing the path of the earth through its orbit for three hours, it appears that the dense shower only occupies a space 87,000 miles in width, hence each meter corresponds to an area 20½ miles square.

Applying proper correction for the effect of the earth's attraction, the dispersion of meteors covered about 10°; although, as seen from the sun, the apparent thickness of the shower belt is only 4′, and its actual thickness therefore is only 8′.

If these meteors come to us though a range of 10°, they represent, not a group, but a wide dispersion through space. The only possible explanation of the wide divergence, therefore, is that they glance when they strike the earth's atmosphere.

This explanation, it is true, has been previously suggested, but it has seemed to be untenable, for the reason that the meteors as we see them always move in straight lines. An ingenious explanation of this was now given. The meteors are small irregular bodies, which, when they strike the atmosphere, are cold and dark, and compress the air before them to such an extent as to compel them to change their course to a path of less resistance; but as soon as the pressure and friction heat them to incandescence, the side which is forward fuses, and is wiped off by the impact of the air, leaving the glowing particles behind, which constitute the trail, and at the same time rounding off the front of the meteor, so that it will thereafter proceed in a straightforward course, like a round bullet, having no longer the sharp angles which at first compelled it to glance. Thus it is that the meteors are dispersed while dark and invisible; but as soon as they become visible, they have assumed the rounded form, which gives them a straight path from the time when we are first able to discern them. Were it not for this dispersion, we might fix the direction of the radiant within an angular distance only one-quarter the apparent diameter of the full moon, and the shower would be seen pouring down in this narrow stream. The radiant last November was in zenith nearly over the Black Sea.

In 1841, Biela's comet came near to Jupiter, and its course was changed. It was at the same time broken into two large and innumerable small fragments.

Comparing the longitude of the meteoric showers before this disruption with that of Biela's comet, a substantial conformity is seen. Afterward, both comet and meteors underwent a radical change of longitude, and still the new position in longitude was the same for both comet and meteors. Comparison of right ascension also gives the same results.

This proves conclusively that the meteors were not separated from the comet until after its disruption, and it follows as a corollary that the disintegration of the comet is in progress, and that it will be ultimately dissipated; which is further apparent from the fact that the comet was not visible at the computed periods of the return in 1859 and 1866. We are now one hundred million miles distant from where the comet ought to be.

The meteoric showers will also gradually become less conspicuous, on the whole, although the earth may occasionally, as last November, pass through a denser portion.

The prominence given at this meeting to astronomy and astronomical physics by the award of the Draper medal seemed to entitle these papers to precedence, leaving till next week the report of Hunt's paper on the Cowles electrical furnace, and its immense practical value in the metallurgy of aluminum and other metals.

Prof. Wolcott Gibbs was elected Foreign Secretary in place of Alexander Agassiz, resigned. W. H. H.

## NIGHT SKY—APRIL AND MAY.

BY RICHARD A. PROCTOR.

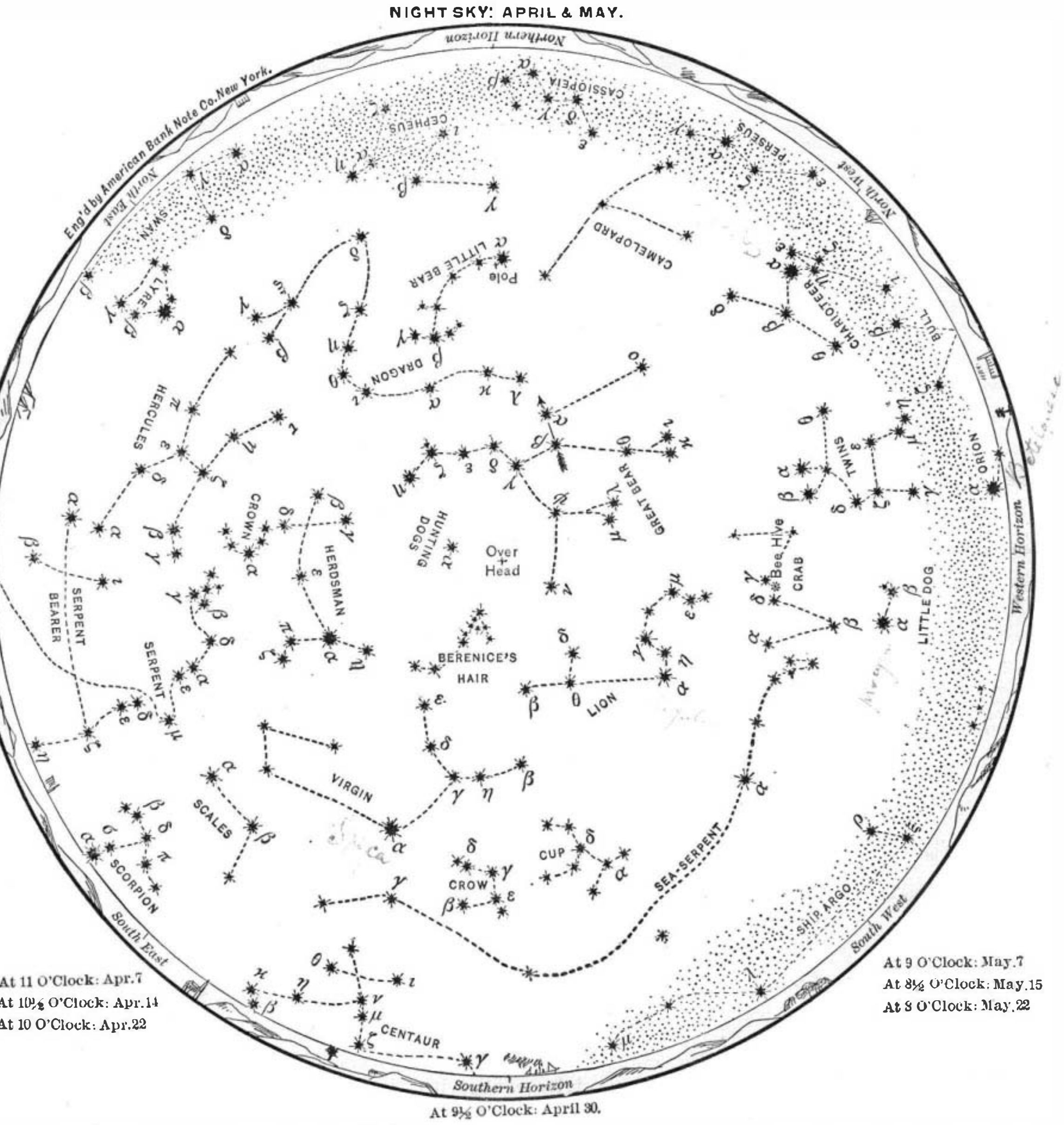
The Great Bear, *Ursa Major*, is now at its highest and nearly overhead, the pointers aiming downward from high up, slightly west of due north. A line from the Pole Star, α of the Little Bear, *Ursa Minor*, to the Guardians of the Pole, β and γ, is now in the position of the minute hand of a clock eight minutes after an hour.

Below the Little Bear we find Cepheus low down to the east of north, and *Cassiopeia* low down to the west of north. *Perseus*, the Rescuer, is setting in the northwest; the Camelopard is above, trying to get on his feet.

The Charioteer, *Auriga*, with the bright Capella is nearing the northwestern horizon, followed by the Twins, *Gemini*, in the west. Further west and higher we find the Crab, *Cancer*, below which is the Little Dog, *Canis Minor*.

The southwestern sky is very barren of bright stars, *Alfard*, the heart of the Sea Serpent, *Hydra*, shining alone in a great blank space. Above the Sea Serpent's head we see the Sickle in the Lion, *Leo*, himself stretching his tail to due south, very high up. *Coma Berenices* is close by, and the Hunting Dogs, *Canes Venatici*, between Coma and the Great Bear.

NIGHT SKY: APRIL & MAY.




At 11 O'Clock: Apr.7
At 10½ O'Clock: Apr.14
At 10 O'Clock: Apr.22

At 9 O'Clock: May.7
At 8½ O'Clock: May.15
At 8 O'Clock: May.22

At 9½ O'Clock: April 30.

In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed; counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

In the south, lower down, we find the Crow, *Corvus*, and the Cup, *Crater*, on the Serpent's back; the Virgin, *Virgo*, extending in the mid-heavens from southeast to south, between the Lion's tail and the Crow. In the same direction, but low down, we find the head and body of the Centaur, *Centaurus*, supposed to have typified the patriarchal Noah.

In the southeast the Scorpion's Heart has just risen, and between the head of *Scorpio* and the Virgin's robes we see the stars of the Scales, *Libra*.

Due east, low down, is the Serpent Holder, *Ophiuchus*, on his back—'tis the customary attitude of heavenly bodies when rising. The Serpent, *Serpens*, held by him is seen curving upward toward the Crown, *Corona Borealis*. The Serpent's head is due west, and above it we see the bright Arcturus, chief brilliant of the Herdsman, *Bootes*.

In the northeast is *Hercules*, his head close to the head of the Serpent Holder. Beneath his feet is the Lyre, *Lyra*, with the brilliant Vega; and the Swan, *Cygnus*, has already half risen above the northeastern horizon.

Lastly, the Dragon, *Draco*, curves from between the pointers and the pole, round the Guardians toward Cepheus, and then retorts its head, with gleaming eyes (β and γ), toward the heel of Hercules.

### Magnetic Qualities of Iron.

It is well known what an influence the quality of the iron in the field magnets has upon the ultimate output in a dynamo, and a case in point is mentioned by Mr. Gisbert Kapp, showing how impossible it is to foretell accurately the performance of a dynamo unless the quality of the iron be exactly the same in the manufactured machine as the sample submitted. In the case of two machines manufactured for him, there was a difference of electro-motive force of 20 per cent between the two, although the machines were of exactly the same dimensions and treated in the same manner. It was imagined that in the first machine the iron magnets had not been sufficiently annealed, in consequence of the shortness of time allowed for the work. A second pair of field magnets were ordered and an extra time allowed for the work, the consequence being that 20 per cent. more electro-motive force was obtained.

### Erratum.

In Abernethy's keying clamp, illustrated on page 242, April 17, 1886, the slots shown in the cut should not extend entirely through the jaws, as represented. They should be about half the depth of the jaws.