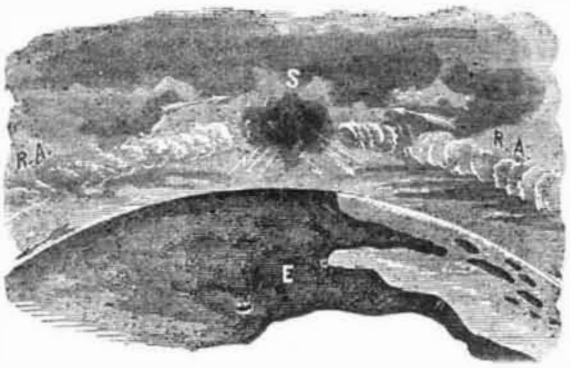
some interesting calculations as to the enormous waste of the rays of light in the solar system. He concludes that "taking all the planets together, great and small, the light and heat they receive is only 1-227,000,000 part of the whole quantity thrown out by the sun. All the rest escapes into free space and is lost among the stars, or does there some other work that we know nothing about. Of the small fraction thus utilized in our system, the earth takes for its share only one tenth part, or less than 1-2,000,000,000 part of the whole." What is that "other work" to which Herschel refers? To this question the discovery of Mr. Crookes suggests an answer. For as Providence has created nothing in vain, so analogy would lead us to expect that the solar rays fulfil many useful purposes which, though long unknown to Science, will hereafter be discovered by the advancing knowledge of man. The present discovery, whatever else it may suggest, affords a new and beautiful illustration of the well known law of the conservation of forces, for it teaches us that the light which is incessantly pouring from the sun is perpetually converted into force, and that this force is utilized in the economy of the Universe, no part of it being wasted, or latent, or lost.

Correspondence.

The Sources of Electricity.

To the Editor of the Scientific American:

It is the general belief that the electricity of the atmosphere is generated by the friction of the air or action of the winds upon the earth's surface, also by the evaporation of moisture. Electricity is easily produced experimentally by either of these means. When we consider the immense surface of the earth and the enormous extent over which these effects are constantly being produced, we have an explanation of the immense reservoir of electricity that exists in the region of rarefied air that encircles the globe. This reservoir is continually being supplied and replenished, mainly by these two causes, evaporation of moisture and friction of the air upon the earth's surface. There is also a continuous outlet to this immense reservoir in the way of silent discharge to the earth, and by atmospheric discharge usually known as lightning. The above figure is given to represent the two great conductors, E being the earth and R A the region of rarefied air that encircles the globe.



Whenever this outward conductor is brought sufficiently near the earth, direct discharges take place; or in other words, lightning occurs. Clouds are conductors, and the above engraving is designed to show how the conductor, which is composed of rarefied air and a cloud, is brought near to the earth. It is simply a conductor of two materials. Thunder clouds extend into the air higher than ordinary clouds. They extend into the region of highly rarefied air. When this occurs, accumulation of electricity into the cloud takes place. The electricity of this immense reservoir flows into the cloud because the cloud is that portion of the conductor which approaches nearest to the earth. S represents a thunder storm floating over the surface of the earth. While this cloud is in favorable condition of form and density, the electricity in this vast reservoir of rarefied air is flowing in the direction of the cloud. The cloud becomes charged, and lightning occurs. While positive electricity is flowing through rarefied air into the cloud, negative electricity is flowing in the surface of the earth in the same direction, and that portion of the earth directly beneath the cloud is charged with electricity of the negative or opposite degree.

It is the belief of the writer that earth currents, which so often show their annoying effects in telegraphy, are the mere counter currents of those that are continually flowing in the almost ethereal regions above, and these upper currents are in continual motion, seeking that portion of the conductor nearest the earth. The force and direction of these currents are as varying as those of the winds.

In the foregoing engraving, the form and relative position, as regards the earth, of this outside conductor is represented. Of course the only visible portion is the thunder cloud. Rarefied air is a conductor, but differing from other conductors, inasmuch as electricity flows through it slowly. In other conductors its speed is comparatively instantaneous. In a former article, this cloud has been compared to a porous standpipe which is filled with or containing water. Suppose we undertake to fill this standpipe. With a certain given supply or head, we can fill it to a certain hight. The hight of the pipe is indefinite, and it is desired to burst it. This can only be done by getting a sufficient hight of water in the pipe. The hight or head, we call accumulation. Now to get sufficient accumulation we must have a certain supply, called quantity. It must have a certain force, called tension, and it must not have too great a leakage. We can, under given conditions, fill this pipe only to a given hight; but to fill it higher, or to the point of bursting, we must increase the quantity—increase the head or decrease the leakage. If the supply is lessened, the quantity accumulated is diminished. If the supply is stopped, the pipe is discharged in time by leakage alone.

The conditions of the thunder cloud are somewhat analagous. It is always charged to some extent. It may not be sufficient to produce disruptive discharge or lightning. It may occur once, and it may occur over a thousand times. We have known such to happen as often as once per second for an hour or more. How very rapid, then, is this flow and accumulation, into the cloud, of electricity from the regions of rarefied air, which the cloud reaches on account of its great elevation!

The earth, with its outer conductor of rarefied air, resembles an immense Leyden jar of almost incomprehensible dimensions, the earth itself being the inner conductor and the heavier strata of air, directly in contact with the earth, serving as the dialectric. The outer conductor is continually being charged, and this source of electrical accumulation is due to the effects of the sun's rays upon the earth. Moisture is evaporated, every particle of which produces its quantity of electricity. When the winds are set in motion, the friction thereof produces its share. Wherever this dialectric is thinnest or interposes least resistance, there accumulation takes place in greater quantity. The dialectric is made thinner by the thunder cloud. Through the agency of the cloud, the two conductors are brought nearer together, and this accumulation finds vent or relief in disruptive charges called lightning. As soon as these thunder clouds assume favorable form or begin to develope themselves, their electricity gathers in greater quantity in this part of the outer conductor, also on the surface of the earth directly beneath.

The hight of thunder clouds is estimated as extending from seven to fifteen miles above the level of the sea.

The origin of thunderstorms is believed to be due to the expansion and rarefaction of the atmosphere. When heated by the sun's rays, it expands and forms a current upwards. The hot air coming in contact with the cooler air above, deposition takes place in form of fog or cloud, and, when sufficiently condensed, falling drops of rain are the consequence. The vapor or cloud of a thunderstorm, as viewed in the neighborhood of the mountains in Pennsylvania, appears to be far above the latter, that is, the lower portions of the cloud are far above the mountain tops. In Central Mexico, the lower portions of these clouds seem to rest or come in contact with the mountains. From observations, I am led to believe that the lower portions of a thunder cloud are from two to three miles above the level of the sea. The tops or higher portions, when observed from these mountains or from a hight of two and a half miles, appear as high as when seen from an ordinary or lower position. That the upper and lighter portions of thunder clouds extend very high is admitted by every intelligent observer. If it be true that the upper portions are about ten miles above the surface of the earth, they extend far into the regions of rarefied air, and thus afford means for the enormous accumulation of electricity with which they are charged.

We have every reason to believe that, in cases of frequent and heavy discharges, the cloud extends to a very great hight. One of the most violent storms ever witnessed by the writer passed over this city on the evening of July 4, 1872. It commenced about nine o'clock in the evening, the rain falling in torrents for about an hour, flooding streets and filling cellars with water. The electric discharges during the greater portion of this time occurred as often as once per second. It was reported that there were over a hundred buildings struck by lightning in this city, and it is more than probable there were as many more, not mentioned. No person was injured by lightning, so far as known, nor was there serious damage to property, except that resulting from the immense rainfall.

It is believed that this thunder cloud, in order that circumstances should favor so many and such violent electrical discharges, must have extended to a very great hight; and the large amount of moisture, in the shape of drops of rain between the cloud and the earth, assisted immensely by reducing the resistance. DAVID BROOKS.

Philadelphia, Pa.

A Use for Bedbugs.

To the Editor of the Scientific American:

A correspondent in a recent number of your journal asks if there is any use for bedbugs. This reminds me of an accidental experiment I once made and had almost forgotten.

If nice fat bedbugs are placed in a saturated solution of nitrate of potash in water, and exposed to the air for several days in an open vessel, there will be no apparent change in the bugs; but there will be in the odor, for now it is as delicate and delicious as before it was rank and disgusting. No doubt the odorous principle could be easily separated, perhaps by digesting with alcohol or ether; and if neatly bottled and labeled, it would yield a large profit to practical perfumers.

The odor is unlike that of any other perfume I have ever smelt, and no one would suspect its low origin. This is one use for the *cimex*; there may be others. C. K.

Cincinnati, Ohio.

VELOCIPEDE RACE.—The inter-university bicycle race, between Oxford and Cambridge, England, took place this year on the road from St. Albans to Oxford, a distance of fifty-two miles. It was won by Hon. Keith Falconer, of Cambridge, in four hours, nine minutes, and twenty-four seconds, with a fifty inch wheel machine. The average speed of the winner was 12½ miles per hour.

Action of Sunlight upon Precious Stones.

Dr. Schnauss has directed attention to the fact that certain minerals are quite sensitive to the action of light. To many of our readers this may seem quite surprising, although some cases of this kind have long been known to mineralogists. Strangely enough this property extends to the very hard minerals, and reaches its maximum in the very hardest of all minerals, the diamond. According to Dr. Flight, under certain circumstances the colored diamond is as sensitive to light as chloride of silver. The ancients knew that certain colored precious stones gradually grew paler in the sun light, and that this was very distinctly the case with the beautiful grass green chrysoprase. They said that, when worn for a long time set in a ring or pin, it finally lost a greater part of its beautiful color; and that this could be recovered by wrapping it up in a cloth soaked in wine and keeping it in a cellar. The latter is evidently one of the numerous phantasies of that age, but the former statement is a fact. Even the much harder, transparent, dark green emerald is also influenced by light in time, as the author found to his sorrow in the case of an emerald ring, which he had worn seven years.

The diamond, however, exhibits the most interesting phenomena under this influence. If colored diamonds are highly heated, the color disappears more or less completely, and in most cases permanently. Sometimes, the color is merely changed by ignition, and the original color may be restored by the influence of the sun's light. A diamond merchant named Martin exposed a diamond to a very high temperature, in order to destroy its brownish color, but the stone became of a permanent rose red. Coster treated another diamond in the same way, and that too turned rose red; but the most remarkable part was that this color was only permanent in the dark, and disappeared in 4 or 5 minutes if exposed to the sun's light, the stone acquiring a weak brown color. This change also took place in a room where the light was by no means bright. Another diamond, of a dirty yellow color, was ignited in a current of hydrogen in a porcelain tube and allowed to cool there. The color disappeared, but not the luster. If this specimen were exposed to diffused light for 6 or 7 minutes, its original yellow color returned. The experiment was repeated in this way, the stone being heated in chlorine gas at as strong a heat as could be obtained by saturating the gas used with benzol vapor; it was farther heated at a lower temperature in a mercury bath, the diamond being wrapped in platinum foil. Each time the color disappeared and remained absent in the dark; but as soon as the stone was exposed for a few minutes to diffused daylight, it regained its yellow color.

These phenomena are thought by Dr. Schnauss to be related to that of phosphorescence. In addition to the cases mentioned by him, we would recall the fact, usually stated in text books on mineralogy, that a variety of topaz from Brazil, when heated, assumes a pink or red hue resembling that of the Balas ruby.

S. H. Mead, Jr.

We regret exceedingly to note the death of Mr. Samuel H. Mead, Jr., of this city, a young inventor and scientist of much promise. After patenting a number of improvements in fire arms, Mr. Mead, some four years ago, devised a safety explosive bullet, which invention he subsequently combined with one of like character patented by General Meigs. The Mead-Meigs shell, as the combination is termed, is a breech-loading metallic cartridge with a hollow explosive bullet containing fine gunpowder. On penetrating flesh or on striking any hard substance, the bullet explodes, tearing the object to pieces. The missile has been used in hunting in the West, and it was Mr. Mead's design to use it in shooting sharks off Martha's Vineyard.

Mr. Mead was an excellent astronomer and optician, and was indirectly known to the readers of this journal through his articles on astronomical subjects, and through his replies to queries of that nature, which we frequently referred to him for opinion and answer. Just before his death, he was bringing to completion a novel device whereby the recoil of a Gatling gun could be utilized so that the reloading would be effected automatically after every discharge, so long as the cartridge receptacle was kept filled. The deceased was but twenty-seven years of age.

Completion of the New Atlantic Telegraph Cable.

After many delays and much expenditure of money, the cable of the United States Direct Submarine Telegraph Company was completed on June 9. It will be remembered that the splendid new ship Faraday, built expressly for the service, left the Thames more than 12 months ago to lay the section between Rye Beach, N. H., and Nova Scotia. The company have leased two wires, belonging to the Franklin Telegraph Company, from Rye Beach to New York, and have opened an office at 16 Broad street in this city, where business will shortly be commenced.

The cable from Ireland to Nova Scotia was laid to within 200 miles of the latter country; but owing to unfavorable weather and the Faraday leaking badly, it had to be cut and the end attached to a buoy. Its construction was fully described on page 40 of our current volume. It is the fifth cable now in use in the Atlantic service, and its contract price ($6,055,000) will enable the company, it is claimed, to make a moderate tariff of charges, and reduce the rates throughout the country. A speed of twenty words per minute is anticipated.

TO CUT glass to any shape without a diamond, hold it quite level under water, and, with a pair of strong scissors, clip it away by small bits from the edges.