volume ever saw the light. Mr. Benjamin's article was singled out by Messrs. Lattimore and Remington as worthy of the first prize, probably because of the following 'practical and otherwise valuable' information which it contains : "All that is required to immediately purify and sweeten a contaminated air-supply, however originated, is to dip a cloth in the liquid (a solution of nitrate of lead and common salt), and hang it up in the apartment." Or perhaps they thought sulphate of iron, charcoal, and table salt were of much greater value than chlorinated lime, mercuric chloride, or mercuric iodide. Their fathers thought so, and therefore the new-fangled notions of bacteriologists must be disregarded as unscientific and impractical. They believed that Dr. Baker's special training as a physician, and his experience as founder of the state board of health of Michigan, as well as member of the committee on disinfectants of the National board of health, unfitted him as a judge of such matters. In spite of his earnest protests, they insisted upon giving the first prize to a paper which he declared was unworthy any prize. Their special training as analytical and pharmaceutical chemists fitted them for just such work, because they knew nothing of Pasteur or Magnin, Koch or Miguel, Sternberg or Klein, other than they happened to see in the *Rochester post* or *Philadelphia ledger*.

G.

Brooklyn, Dec. 11.

The English sparrow.

The despised sparrow is entitled to a good word if he can secure it. He has come to stay, and no amount of vituperation will displace him. 'He is too many,' and has spread over too large a portion of the union. The sparrows crossed the Mississippi River at Clinton, Io., about 1875, and have increased largely. They confine themselves principally to the railroad buildings and some of the business blocks, though they occasionally nest on private houses.

When this town was founded, twenty-five years ago, there were no trees or shrubbery near, and consequently few birds. Now the town looks like a forest in the distance. The consequence is that robins, thrushes, orioles, blackbirds, bluebirds, and many other birds, are very numerous, and seem to be increasing. Numbers of blue jays nest in the shade-trees, and stay with us during winter. The sparrows have never seemed to drive any away, as each year more nests of summer birds have been observed. They confine themselves to the open spaces and streets, and do not nest or frequent the trees or shrubbery. They have never been observed in the fields outside of town, and do no injury to fruit or seeds in gardens. They live largely on insects, as has been shown by examining their crops. In winter they are mainly dependent on the seeds and grains they can pick up. They fall victims to the jays and the butcher birds, but a crowd of them makes a good fight against the aggressors. There are millions of them in every large town, on the railroads of this state, and there is no way of exterminating them, and no wish to on the part of unprejudiced people. There is no law for their protection in this state, only a general friendliness toward them as toward all small birds.   P. J. FARNSWORTH.

Clinton, Io., Dec. 10.

It must be admitted that the English house-sparrow will eat seeds and fruit, but it should be remembered that the young sparrows are fed chiefly on insects and caterpillars ; and a good English authority (Yarrell) observes that " so great is the number of these consumed by the parent birds and their successive broods of young, that it is a question whether the benefit thus performed is not an equivalent even for the grain and seeds eaten by the adult birds at other seasons of the year."

Dr. Elliott Coues, in his notes to Stearns' 'New England birds,' advocates the extermination of the English sparrow, and calls it ' the parasite.' This is not a translation of its scientific name, Passer domesticus, and does not accord with any known habit of the birds in question. Dr. Coues has no fault to find with a native tree-sparrow (Spizella monticola), which he says exists in large quantities, and feeds only on grain and seeds. All specimens shot by Dr. Coues had their crops full of seeds.

The sparrows which damage the crops and orchards in England are another species, called the field-sparrow. I have seen these in flocks of over a thousand rise at one time from a field of grain. This is, I presume, the bird described by Dr. Coues as Passer montanus. He states they are now found in New England, but I never heard of their having been imported.

I rather doubt the stories about the English sparrows molesting the bluebirds at breeding time. It is well known that most birds are very pugnacious at this period, and I am personally acquainted with the fact that bluebirds are particularly courageous at this season. On one occasion a bluebird made its nest in my garden, in the hollow of a tree, about six feet from the ground. One day, when busy inspecting the nest, I received a violent blow on the side of the head, and, on looking up, saw the parent bluebird flying away. I found that whenever I placed my hand in the nest, I was attacked in this manner. I apprehend, that, if a bluebird will attack a man in defence of its nest, it is not likely that a sparrow would do so with impunity.

I notice that Dr. Bechstein, in his standard work on birds, published as one of Bohn's library, states, that although the house-sparrow has no song, he can be educated to sing equal to the canary. I was also surprised to find in the same work (p. 249) that the house-sparrow could be taught to speak: it mentions a clergyman of Paris who had two of these birds which could repeat the fourth, fifth, sixth, and seventh commandments. It is gravely stated that when these birds quarrelled over their food, " one of them would admonish the other with the remark, ' Tu ne voleras pas.' "

Giving due credit to the house-sparrow for all his accomplishments, I fear he can speak the French language only in fable.   JOHN MICHELS.

New York, Dec. 10.

The temperature of the moon.

Now that the temperature of the moon has become a subject of investigation with the aid of recent refinements in the methods of observing very small intensities of heat radiation, it may be well to also look at the matter from another stand-point.

The condition which determines the static mean temperature of the whole mass of the moon is, that its rate of losing heat by radiation from its surface shall be exactly equal to the rate with which it receives and absorbs the heat radiated from the sun,

in comparison with which the heat coming from the stars, and that radiated and reflected by the earth, may be neglected without any sensible error. But by the generally recognized principle that the relative radiating and absorbing powers of bodies are equal, the ratio between radiation and absorption is the same for all bodies at a given temperature; so that it is not necessary to consider the radiating power of the moon, but to simply satisfy the condition that the moon, with a surface of maximum radiating power, such as a lampblack surface, shall radiate heat as fast as it is received from the sun.

All bodies are so constituted that their absolute radiating power is a function of the temperature, the former increasing with the latter, but by no means in proportion. If, therefore, we know the relation between the temperature of a body and its rate of radiating heat, and also know the rate with which it is receiving heat from its surroundings, we can, by means of the preceding condition, form an equation of condition which determines the temperature.

According to Pouillet's determination from the experiments of Dulong and Petit, a square centimetre of surface of maximum radiating power, and at the temperature of 0° C., radiates 1.146 calories of heat per minute ; and hence, by the law of Dulong and Petit, the rate of radiating heat for any other temperature θ, is $1.146\mu^\theta$, in which $\mu = 1.0077$. The rate with which a square centimetre of surface normal to the direction of the sun's rays receives heat from the sun is what is called *the solar constant*, usually denoted by A. Putting, therefore, s for the area of the moon's surface in square centimetres, and a for that of a great circle, the rate with which heat is radiated from the moon's surface is expressed by $1.146\,\mu^\theta s$, and the rate with which it is received from the sun, by Aa. Hence, by the conditions above, since $s = 4a$, we get in the case of the moon in space, in which it loses heat by radiation only, and receives it from the sun only, the equation

$$\mu^\theta = \frac{A}{4.584}$$

for determining θ where A is known. Since $\log \mu$ is exactly equal to 1·300, this may be put into the following convenient and practical form : —

$$\theta = 300 \log \frac{A}{4.584} = 300\,(\log A - 0.6612).$$

From this equation, deduced as a simple case from a more general and mathematical treatment of the subject in the 'Temperature of the atmosphere and earth's surface,'[1] the writer, with the assumed value of $A = 2.2$, deduced the value of $\theta = -96°$ C. But as there is some uncertainty with regard to the value of this constant, since some of the solar rays may be entirely absorbed before reaching the earth's surface, and it is thought by some to be considerably greater than this, we shall put it here equal to 2.5. With this value we get $\theta = -79°$. This must be understood to be the mean surface temperature of the moon, or, more accurately, the temperature of a surface uniformly heated which would radiate as much heat as the surface of the moon, which, of course, has very different temperatures on opposite sides at any given time.

The law of Dulong and Petit being an empirical one, which satisfied the experiments from 0° to 300° only, there is some uncertainty in extending it down to —79°; but this is very small in comparison with what

[1] Professional papers of the signal service, No. xiii.

it is in extending it in the other direction, up to the temperature of the sun, as has been done by Pouillet and others, in forming an equation for determining its temperature. The uncertainty in the true value of A, together with that in the extension of the law down to so low a temperature, causes some uncertainty in the mean temperature of the moon as thus determined ; but this is not very great in a matter of this sort, for it amounts to only 17° in an uncertainty of one-eighth part in the value of A.

But when we attempt to determine the temperature of the side of the full moon exposed to the sun and earth, the uncertainty becomes very much greater. In this case the heat is not only radiated from the surface, but it is also conducted inward from the surface heated far above the mean temperature of the moon, and stored away for the time. The rate with which it is conducted in depends upon the conductivity and capacity of the lunar soil for heat, which are unknown to us ; and the problem would be extremely complex if they were known. The temperature of the moon's surface, in this case, can only be determined for the two extreme hypotheses of infinitely great and infinitely small conductivities for heat. Upon the first hypothesis, the heat received and absorbed by the moon would be instantly distributed through the whole mass, and radiated equally by all parts of the moon's surface, and the temperature of the part exposed to the sun's rays would be the mean temperature of the moon as obtained above. Upon the other hypothesis, it would not be conducted away at all from the surface receiving it, but, in case of a static temperature, it would all have to be radiated away by the same surface receiving it. Hence, in this case, instead of the radiating surface being four times as great as the surface, or normal sectional area receiving it, it is only equal to it for the part of the moon's surface upon which the sun's rays fall perpendicularly, and we must therefore have $1.146\mu^\theta = A$, or

$$\theta = 300 \log \frac{A}{1.146} = 300\,(\log A - 0.0592),$$

instead of the preceding similar expression.

With the assumed value of $A = 2.5$, this gives $\theta = 101°$ for the temperature of the central part of the moon's disk as viewed from the sun, and from the earth at full moon. For other parts, the value of A in the preceding expression must be multiplied into the cosine of the angle of incidence of the sun's rays upon the moon's surface, and thus this expression will give the temperature down as low as it is safe to extend Dulong and Petit's law. The same results would be obtained sensibly with any ordinary conductivity for heat if the same side of the moon were permanently exposed to the sun, for the temperature gradient by which the heat would be conducted inward would soon become so small, in this case, that the rate by which heat would be conducted inward would be insensible, as in the case in which heat is conducted outward from the interior of the earth.

The result above, of 101°, which is a little above the temperature of boiling water, must be regarded simply as a limit beyond which, in a large range of uncertainty, the temperature cannot go. The other limit is — 79°. If we suppose the temperature of the warmest part of the moon's disk to fall halfway between these extremes, it would be a very little above a freezing temperature.   WILLIAM FERREL.