outnumber those of science. But let the official announcements of the schools speak for themselves.

	No. Students.	Teachers Grammar.	Teachers Mathematics.	Teachers Science.	Remarks.
1st District, - -	800	6	9	1	
2nd " - -	979	2	5	2	Physiology taught by a physician.
3rd " - -	662	2	5	2	
4th " - -		1	1	1	Not yet opened.
5th " - -	360	1	2	1	
7th " - -	360		1	2	The science teachers devote but part of their time to their own dept.
8th " - -	579	2	2	1	Science teacher is also instructor in gymnasium.
9th " - -	666	2	2	1	
10th " - -	711	1	1	2	Assistant teaches history and zoology.
11th " - -	500	1	1	1	The science teacher is also teacher of ancient languages.
12th " - -	530	1	1	1	
13th " - -	526	1	1	1	Science teacher teaches grammar also.
12 schools,	6,673	20	31	16	

By above table it will be seen that for 6,673 students some sixteen science teachers are provided, but in six instances these teachers give instruction in other branches, leaving but ten teachers devoting all their time to scientific instruction. The extreme illustration is seen in the first district, where fifteen teachers instruct in mathematics and grammar to one solitary teacher in science.

If, however, we further examine the catalogues, we find that in the elementary course (which is the only course the great bulk of the students take) the sciences required are physiology and hygiene, elementary natural philosophy and botany. To teach physiology and hygiene to teachers, it might readily be supposed that a person trained in medicine would be demanded, but only *one* such trained teacher is found in the twelve schools. A fair knowledge of elementary natural philosophy is imparted, but the work in botany is abridged to so short a time that it is questionable whether the graduates are able to do much with it when they become teachers themselves.

In the scientific course, which extends over two years, chemistry, zoology and geology are taught for one term each, natural philosophy for two terms. The same criticism is applicable to the scientific work in this course as is made above for the work in botany.

If, from the strictly professional schools we now turn to the academies and colleges, which prepare a large proportion of the teachers of the state, we will find much the same condition of affairs. As a rule, the academies and seminaries can afford but a single science teacher. With the colleges it is but little better, except that largely these institutions have been able to secure two professors for the scientific branches, chemistry and physics being assigned to one, while geology and the organic sciences are given to the other. Pennsylvania has twenty-six colleges for men (part of these co-educational) and eleven for women (Last report of U. S. Commissioner of Education). Of these thirty-seven institutions, the University of Pennsylvania, Lehigh University, the University of Western Pennsylvania, Lafayette College and Bryn Mawr College are the only ones in any wise fully equipped for scientific work. In some cases there are more than two science professors in one institution, but in other cases there is but a single instructor. The writer has not, in his possession, catalogues of all the colleges, and hence cannot make a tabulated statement, as has been done for the professional schools.

The answer then is reached. Scientific instruction in the public schools is a failure because teachers are not trained to impart it. At present, mathematics and grammar are considered of far more importance than science in the training of teachers. How long this state is to continue no one can affirm. The only solution of the problem is better all-round preparation for teachers.

ELECTRICAL COOKING.

Some years ago (in December, 1890) the writer made some experiments with a view to determining the efficiency of electrical cooking, as the general opinion at that time was that any such employment of electricity would be too inefficient to be commercially practicable, and the writer had reason for believing otherwise. These experiments showed conclusively that the use of electricity for cooking was more economical and efficient than the use of coal in an ordinary cooking stove, but, as it was the intention of the writer to take out patents on several points, these results were not published at the time.

Since 1890, the fact of the efficiency and low cost of electrical cooking has been generally recognized, not only theoretically, but also in practice. But although there are now at least a dozen companies engaged in producing electrical cooking apparatus, and their productions are finding their way into hotels, dining cars, steamers, and private houses, so far as the writer knows, there have not as yet been published any tests of the relative efficiency of the new apparatus and the ordinary cooking stove. For this reason the following results may be of interest, the more especially as the results show the truly awful waste of fuel at present taking place, and the direction in which improvement both in heating and cooking must be looked for.

Details of apparatus used in making test. The cooking stove was of the ordinary type, the enclosed grate which holds the fuel being twelve inches long by six inches wide by six inches deep. Area of top of stove, seven square feet. Size of oven, 2x1.6x1.6 feet. Number of orifices on top of stove, six. Orifices eight inches in diameter. A damper is so arranged that the heat passes directly up the chimney, after passing the six orifices for culinary utensils, or may be directed around the oven, after passing two orifices only. The total radiating surface is 37,200 square centimetres, approximately, and the average all day temperature, so near as could be ascertained, nearly 100 degrees C.

The box for electrical heating was a cube whose sides were one foot in length. It was of polished tin, but no attempt was made to render it more bright than it was when bought. The box was heated inside by passing a current of electricity through a coil of iron wire wound inside the box. The watts used in heating could be found by multiplying the current passing through the coil by the difference of potential between its ends, a thermometer inserted in the box giving the corresponding temperature.

The total quantity of coal used in the stove, obtained by taking the average of several weeks, was thirty pounds per day. Taking the average value for the thermal equivalent of good coal, this would represent the production of 100,000,000 calories, and therefore the efficiency will be given by dividing the total number of calories of useful work obtained from the stove by 100,000,000.

We can divide the useful calories into three classes, which we will call the *c*, *r*, and *p* calories, the *c* calories being those actually used in cooking, the *r* calories being those used in raising the water in which the substance is cooked to a cooking temperature, and the *p* calories being those calories used in cleaning the cooking utensils, etc. In the case taken, the *c* calories amounted to approximately 30,000*.

The cooking efficiency, or the ratio of the calories used in cooking to the total watts in the coal, is therefore only .03 (three one-hundredths of one per cent).

The *r* calories amounted to 435,000. Adding them to the *c* calories, we get the total cooking efficiency to be .46 (46 one-hundredths of one per cent).

The *p* calories amounted to 2,256,000 approximately. Adding them to the *c* and *r* calories, we get the total all day ratio of the useful watts to the total calories in the coal to be 2.7 per cent.

The addition of the calories used in heating a hot-water apparatus for baths, etc., adds about 1.5 per cent to the efficiency, making the total all day efficiency of the stove above 4.2 per cent.

The writer has been informed that Professor Tyndall, in a test of the efficiency of a stove, obtained the figure of six per cent. This, however, must have been the maximum efficiency, as, without the hot-water coils (which were probably not in the stove tested by Professor Tyndall) the all day efficiency can hardly reach three per cent.

There remain, out of the original 100,000,000 calories in the coal, about 96,000,000 to be accounted for. These evidently are lost up the chimney or are radiated out into the room. We may make a rough calculation of their relative and absolute amounts.

The total radiating surface is, as given above, 37,200 square centimetres. Taking the average difference of temperature between the stove and the room as eighty degress C., and taking the coefficient of emissivity of the blackened surface of the stove as .0004, we find for the total loss in radiation, for the day of ten hours, 64,800,000 calories. The remaining 30,000,000 calories must go up the chimney, or be left in the unconsumed coal.

We may tabulate the results thus:

1. Total amount of heat in coal, -	100,000,000 k.
2. Amount used in actual cooking, -	30,000 k.
3. Amount two plus amount used in raising water in which food is cooked to cooking temperature, - - - -	465,000 k.
4. Amount used in cleansing cooking utensils, etc. (2,256,000) plus amounts 2 and 3, - - - - -	2,750,000 k.
5. Amount used in heating bath, approximately, - - - - -	1,500,000 k.
6. Amount used in warming room, -	64,800,000 k.
7. Amount lost up chimney, and through incomplete combustion, -	31,000,000 k.

From these figures we see that the name cooking stove is really a misnomer, for of the total amount of useful work which is got out of the stove, i. e., 69,000,000 calories, only 30,000, or about .04 per cent are utilized in cooking, the rest being spent in warming the room, and in heating water. It will be noticed that cooking stoves seem to be designed to present as much surface for radiation as possible, and that the efficiency of the stove as a water heater is only four per cent, while, with proper design, a water heater should have at least fifty to sixty per cent efficiency.

The efficiency of the electric heater is very simply calculated.

*The c calories were obtained by weighing the food before and after, and taking the loss in weight as due to evaporated water. This, of course, is not strictly accurate, but it must be a fairly close approximation.

A box, whose interior volume is eight cubic feet will cook the same amount as the stove experimented upon. The surface radiating heat will be, in this case, about 24,000 square centimetres, and, taking the emissivity at .00025, we get for the total loss, since the current will be only used six hours, as against the ten of the stove (as no appreciable time is required to warm the electrical oven, and the current may be cut off when not in use) a total of 7,000,000 calories lost by radiation per day, when there is not a heat-retaining covering, such as asbestos, and the bare tin is exposed to the air. It would be only 55,000,000 in actual practice, as one side would rest on a table.

By the use of proper insulation, the loss can be reduced to one-tenth of this, or 700,000 calories. We thus obtain the following table.

1. Amount used in actual cooking, - -	30,000 k.
2. Amount lost in radiation, - - -	700,000 k.
Total cost at 1 cent per 100,000 calories (which is the actual selling price of the electric companies at present, or slightly above it, in some cities)	7.3 cents.

If we include the amount of heat used in heating the food up to cooking temperature, we get,

1. Amount used in actual cooking plus amount used in heating up to cooking temperature, - - - - -	465,000 k.
2. Amount lost in radiation, - -	700,000 k.
Cost at 1 cent per 100,000 calories, -	11.65 cents.

If we include the amount of heat used in heating water for cleaning kitchen utensils, water for bath, etc., we get the following:

1. Amount used for cooking plus amount used for heating to cooking temperature plus amount used for heating water for cleaning kitchen utensils, water for bath, etc.,	4,250,000 k.
2. Amount lost in radiation, - -	700,000 k.
Cost at 1 cent per 100,000 calories, -	42.5 cents.
The cost of the thirty pounds of coal, at $6.00 per ton, is - - -	8 cents.

We see, therefore, from these figures, that, so far as actual cooking is concerned, electrical cooking is about ten per cent cheaper than cooking with an ordinary stove.

When we use the electric stove to heat the water in which the food is cooked to boiling point, we see that electric cooking is thirty-five per cent more expensive, if we take the ordinary prices ruling at present. As, however, a load due to cooking comes at a time of the day when a load is much desired by station managers, and would give a return at a time when the dynamos are practically doing nothing else, it is certain that there would be a deduction from the ordinary lighting rates, and the electric oven would compare favorably with the cooking stove under those conditions.

When, however, we come to use electricity as a means of heating water, for any purpose, we see that the electric cannot hope to compete with the ordinary method, uneconomical as the latter is. We are led, therefore, to the following, as the most economical method.

A boiler for heating water can readily be designed that shall have an efficiency of fifty per cent. This should be used for heating water, and also for heating the house, by means of the ordinary method of tubes. Means of effecting this combination will readily suggest themselves.

The electric oven should be used for cooking.

With this system we get the following table:

1.	Cost of electricity for cooking as above,	7.3 cents
2.	Cost of heating water, for purposes as given above, and the same amount, in boiler of fifty per cent efficiency, with coal at same price as mentioned above, allowing for loss through radiation for day of twelve hours,	1.2 cents
	Total cost,	8.5 cents

It will thus be seen that there is practically no difference between electricity and the ordinary cooking stove, so far as cost is concerned, and it is almost needless to point out the advantages of the electric oven over the cooking stove.

In the first place, we have absolutely no dirt, the electrical oven being lined with porcelain enamel, which can be cleaned with the greatest ease. In the second, we have practically no heat outside the oven to heat the room in summer. Then we have absolute regulation of the temperature. If the oven is cold, and we require a temperature of, say, 100 degrees C. to cook something, the automatic regulator is set to 100, and in less than a minute the temperature has risen, and remains exactly at that temperature. Again, if it is desired to only cook for a certain time, say two hours, the cut-out is set for two hours, and at the end of that time the current is either stopped entirely, or is lowered so as to give any reduced temperature that may be desired.

In conclusion, we may say that the electric oven is bound to come, if only on the score of convenience and accuracy. If cheapness were the only consideration, we should still be burning tallow candles or gas, but people, and especially the American people, will always decide in favor of what is most convenient, so long as the difference in expense is not so great as to form a serious burden, and the above data will, it is thought, show that, used in a proper manner, the expense of electrical cooking need not be seriously taken into account.

It will be seen that of every 100 tons of coal used in a cooking stove, ninety-six tons are wasted. It is difficult of course, to get exact figures, but it is probable that the waste in the city of New York alone is not far from 1,000,000 tons per annum.

With the electric stove, though the cost does not greatly differ, yet by far the larger proportion of the expense is due to the labor, interest on plant, and canalization, so that (taking the efficiency of the boiler, engine and dynamo as ten per cent) the electrical oven, for the same amount of useful calories, uses only one-fourth as much coal as the cooking stove, and from a social-economical point of view, is much to be preferred, for the more we can live on the world's interest, which is labor, and the less we draw from the world's capital of fuel, the better. R. A. F.

MOUSE TRAPPING.

BY FRANK BOLLES, CHOCORUA, N. H.

LATE in August the mice of our White Mountain woods, fields, and meadows, begin to show an increasing interest in corn, sweet apples, and other kinds of bait usually used in effecting their capture. In the early summer trapping them is slow work, but the chill of autumn seems to stir them to fresh activity in the gathering of food, and then pursuit of them becomes really interesting. This year I am taking them alive in order to learn more about their habits during the winter. Where, in previous years, I have set the deadly little "cyclone" traps, I am now setting the common woven-wire trap with a revolving wheel attached. For the ordinary white-footed, or deer mouse (*Sitomys americanus*), I have only to bait the trap with kernels of corn or a bit of sweet apple, and place it at sunset near my wood pile or under the lumber heap back of my barn, and the sound of the whirling wheel is soon heard. For the long-tailed, gray, white-footed mouse (*Sitomys americanus canadensis*), I go to pine stumps in the woods, or to the old logs on the shore of a pond far from houses, and feel confident of taking him wherever I have previously found traces of his presence.

It is also easy to capture the short-tailed, brown meadow mouse (*Arvicola pennsylvanicus*), who always seems to me as much like a diminutive bear as the white-footed mouse is like a tiny deer. His place of abode is readily detected, for he makes long runways in the grass leading to the holes in the ground through which he reaches his burrow. Sometimes I find him under a plank bridge which crosses a moist spot on the edge of the mowing land, but oftener I trap him in the long matted meadow grass where his paths lead here and there in search of food or water. As a rule I catch him in broad daylight when he is most active. *Evotmys rutilus* has a keen eye for protective colors. I find him most frequently in dark, damp woods, remote from houses, domiciled in hemlock stumps. His chestnut fur matches the color of a decaying stump so closely that he seems like an animated portion of the red wood. He does not, however, confine himself to the forest, for I have caught at least one of his family, close to my barn. Neither does he limit his range to low land, for I have secured specimens a thousand feet above his favorite swamps.

By far the most beautiful of the New England wild mice is the jumping mouse of the woods (*Zapus insignis*). For him I walk back a mile from my house through lonely pastures and birch woods to a mountain stream which comes splashing over a rocky bed in a dark ravine. It is not on the first, or even the second day, that he condescends, or dares, to enter the trap, although that dangerous engine is carefully covered and disguised with leaves, ferns and bits of growing moss, until it looks like a piece of the wild wood itself. At first he eats the kernels of corn or the pieces of apple which are placed farthest from the trap. Then, night by night, he comes nearer, until at last, having eaten all the corn and apple outside of danger limits, he ventures too far and is caught. Probably *Zapus hudsonius*, the common jumping mouse, is to be found in this vicinity, but thus far I have not secured him, although his cousin with the white-tipped tail might almost be called abundant. A seventh species, too well known in his customary resorts, is *Mus musculus*, the old world pest of the pantry.

Trapping mice in "cyclones" often results in supplying moles and shrews with food which they seem greatly to enjoy. In fact, *Sitomys* himself is only too willing to devour the tender portions of his own kindred. By using the wheel trap and taking my mice alive, I am not annoyed by the flesh-eaters.

SUBMARINE PHOTOGRAPHY.

BY JOHN HUMPHREY, LONDON, ENGLAND.

SEVERAL of the difficulties experienced in endeavors to ascertain the natural relations of objects existing at considerable depths under water have been overcome by M. Louis Boutan, in a remarkably ingenious manner, and the contrivances he adopted are described in a recent communication to the Paris Academy of Sciences.

He prefers to use a small camera in which several plates can be exposed consecutively, and encloses this in a rectangular, water-tight metal box, into the sides of which plates of glass are inserted to serve as windows. The camera can be so disposed that the lens may face all the windows in turn, if desired, and exposures are regu-