and 47 'pan;' for 'dog,' 6 words and 1 blank, with 10 errors; for 'pod,' 51 words and 64 blanks, with 270 errors, of which 'hog' is responsible for 85, 'hod' for 36, 'pog' for 26, 'hard' for 25; for 'land,' 14 words and 12 blanks, with 63 errors, the word being written 'lamb' 42 times; for 'few,' 11 words and 10 blanks, with 15 errors; for 'cat,' 5 words, no blanks, and 5 errors. Of course, these errors may be due to defects elsewhere than in the power of sound-discrimination, e.g., in the power of translating auditory into visual symbols; but the variety and nature of the errors are certainly interesting. If we classify the nature of the confusions, we find that in the vowel-sounds, *a*, as in 'fan' and 'cat,' is most apt to be heard as *a* long 8 of 16 times; that the *e* of 'pen' is heard as a short *a* 69 of 84 times; the *o* of 'dog,' 'log,' 'long,' 'pod,' as a short *u* 83 of 132 times; while the *ew* of 'few' is about equally often regarded as various other sounds. With regard to consonants, *d*, as in 'dog,' 'pod,' becomes hard *g* 132 of 199 times; the *g* of 'dog' becomes *v* 67 of 82 times; the *p* of 'pen,' etc., becomes *h* 240 of 278 times; the *n* of 'pen,' etc., becomes *m* 56 of 78 times; the *ng* of 'long' becomes *n* 7 of 15 times; while *h*, *t*, and hard *c* have no sounds with which they are specially confused. These facts should be of some importance to philologists, and will perhaps agree with the laws of language and dialect transformations.

Color and Taste. — The peculiar association of a color with a sound by which a certain sound will at once vividly arouse a definite color, is quite normal, and has of recent years been frequently described. The association of color with smells is a much rarer phenomenon, and of color with tastes perhaps rarer still. Dr. Férè gives an account of a woman, who, after taking vinegar, saw every thing red for a few minutes, and then every thing as bright green for more than an hour. Dr. Férè explains this as due to a similarity in the subsidiary emotional effects accompanying the sensation.

HEALTH MATTERS.

Use of Tobacco.

C. W. LYMAN, in a communication to the *New York Medical Journal*, discusses in a very entertaining way, tobacco, its use and abuse. Tobacco, he says, contains an acrid, dark-brown oil, an alkaloid, nicotine, and another substance called nicotianine, in which exist its odorous and volatile principles. This description of the active principles of tobacco is of importance to smokers; for, when tobacco is burned, a new set of substances is produced, some of which are less harmful than the nicotine, and are more agreeable in effect, and much of the acrid oil — a substance quite as irritating and poisonous as nicotine — is carried off. These fire-produced substances are called, from their origin, the 'pyridine series.' By great heat the more aromatic and less harmful members of the series are produced, but the more poisonous compounds are generated by the slow combustion of damp tobacco. This oil which is liberated by combustion is bad both in flavor and in effect, and it is better, even for the immediate pleasure of the smoker, that it should be excluded altogether from his mouth and air-passages.

Smoking in a stub of a pipe is particularly injurious, for the reason that in it the oil is stored in a condensed form, and the smoke is therefore highly charged with the oil. Sucking or chewing the stub of a cigar that one is smoking is a serious mistake, because the nicotine in the unburned tobacco dissolves freely in the saliva, and is absorbed. 'Chewing' is on this account the most injurious form of the tobacco habit, and the use of a cigar-holder is an improvement on the custom of holding the cigar between the teeth. Cigarettes are responsible for a great amount of mischief, not because the smoke from the paper has any particularly evil effect, but because smokers — and they are often boys or very young men — are apt to use them continuously or at frequent intervals, believing that their power for evil is insignificant. Thus the nerves are under the constant influence of the drug, and much injury to the system results. Moreover, the cigarette-smoker uses a very considerable amount of tobacco during the course of a day. 'Dipping' and 'snuffing' are semi-barbarities which need not be discussed. Not much effect is obtained from the use of the drug in these varieties of the habit.

Nicotine is one of the most powerful of the 'nerve-poisons' known. Its virulence is compared to that of prussic acid. If birds be made to inhale its vapor in amounts too small to be measured, they are almost instantly killed. It seems to destroy life, not by attacking a few, but all of the functions essential to it, beginning at the centre, the heart. A significant indication of this is that there is no substance known which can counteract its effects: the system either succumbs or survives. Its depressing action on the heart is by far the most noticeable and noteworthy symptom of nicotine-poisoning. The frequent existence of what is known as 'smoker's heart' in men whose health is in no other respect disturbed is due to this fact.

Those who can use tobacco without immediate injury will have all the pleasant effects reversed, and will suffer from the symptoms of poisoning if they exceed the limits of tolerance. These symptoms are: 1. The heart's action becomes more rapid when tobacco is used; 2. Palpitation, pain, or unusual sensations in the heart; 3. There is no appetite in the morning, the tongue is coated, delicate flavors are not appreciated, and acid dyspepsia occurs after eating; 4. Soreness of the mouth and throat, or nasal catarrh, appears, and becomes very troublesome; 5. The eyesight becomes poor, but improves when the habit is abandoned; 6. A desire, often a craving, for liquor or some other stimulant, is experienced.

In an experimental observation of thirty-eight boys of all classes of society, and of average health, who had been using tobacco for periods ranging from two months to two years, twenty-seven showed severe injury to the constitution and insufficient growth; thirty-two showed the existence of irregularity of the heart's action, disordered stomachs, cough, and a craving for alcohol; thirteen had intermittency of the pulse; and one had consumption. After they had abandoned the use of tobacco, within six months' time one-half were free from all their former symptoms, and the remainder had recovered by the end of the year.

A great majority of men go far beyond what may be called the temperate use of tobacco, and evidences of injury are easily found. It is only necessary to have some record of what the general health was previous to the taking-up of the habit, and to have observation cover a long enough time. The history of tobacco in the island of New Zealand furnishes a quite suggestive illustration for our purpose, and one on a large scale. When Europeans first visited New Zealand, they found in the native Maoris the most finely developed and powerful men of any of the tribes inhabiting the islands of the Pacific. Since the introduction of tobacco, for which the Maoris developed a passionate liking, they have from this cause alone, it is said, become decimated in numbers, and at the same time reduced in stature and in physical well-being so as to be an altogether inferior type of men.

ELECTRICAL SCIENCE.

Some New Tests of Secondary Batteries.

IN the last two years the improvements in storage-batteries have been such as to indicate the near approach of the time when they can be economically used for street-car work. Indeed, it is now a question whether, under favorable conditions, they cannot advantageously replace horses; and the result of the experiments on the Fourth Avenue Road in New York, where ten storage-cars will soon be regularly operated, will be awaited with interest.

Dr. A. von Waltenhofen, in the *Centralblatt für Electrotechnik*, gives the results of some interesting experiments on the Farbaky-Schenck accumulators that have a direct bearing on the subject of electric traction. But before giving the results, it is well to call to mind the points in which the present storage-cells are lacking. The principal point is in the small discharge-rate, necessitating a large number of cells being carried by each car (from 3,200 to 4,500 pounds), a corresponding increase in the weight of the car itself to give the strength necessary to sustain this increased weight, a larger outlay for battery and a corresponding depreciation, a greater power to move the greater weight, and the necessity of re-laying much of the track now in use with heavier rails and a better roadbed. For instance: the weight of an ordinary 16-foot car is from 6,000 to 7,000 pounds. Equipped with motors and storage-battery, the weight is about 13,000 pounds. A car equipped with this weight of battery can be run for from 45 to 60 miles, depending on the conditions of the track and the type of equipment.

Now, what is wanted is a cell with, say, the same storage-capacity and weight, — even with the same rate of depreciation, — but which has a normal rate of discharge and charge of four or five times that of the present type. We could then use from 1,000 to 1,500 pounds of battery on a car, — enough to make one or two round trips, — reduce the total weight of the car to 9,000 pounds, decrease the investment and cost of renewal three or four times, and allow the present car bodies and tracks to be used without any considerable alteration. Under these circumstances (and there is no doubt the conditions will be sooner or later attained), street-car traction by secondary batteries would be an assured and immediate success for any ordinary condition of grade.

Dr. von Waltenhofen's experiments are of interest in this connection, because of the very rapid discharges to which he subjected the Farbaky-Schenck cell, with apparently excellent results as to efficiency and freedom from harmful effects. The cell in question had seven positive and six negative plates, weighing 47 pounds, the total weight of the cell being about 60 pounds. It was constructed with a view to discharging it at 100 ampères, — five times the normal rate. The plates of this type of storage-cell have been described in this journal. They are of a modified 'grid' form, the holes being filled with a mixture of red lead and coke, or other porous material, moistened with sulphuric acid.

The cell was first completely charged, and then discharged at a rate of 100 ampères, until the potential difference at the terminals fell from 1.87 to 1.78 volts. The capacity was 166 ampère hours. Then the cell was charged at 20 ampères, and discharged at 100 ampères as before, but only 100 ampère hours were put in. 88 ampère hours were returned, giving an efficiency in ampère hours of 88 per cent. In total energy the efficiency was 77 per cent. It is evident, however, that these figures are much higher than would be obtained if the cell was fully charged. In another experiment the discharge-rate was increased to 200 ampères, the cell was charged with 200 ampère hours, and the output was about 130 ampère hours, — a current efficiency of 65 per cent, with a total efficiency of from 45 to 50 per cent. It is stated that neither of these discharges injured the cell in any way. A current of 300 ampères was then tried, and the cell kept up its potential difference reasonably well for about fifteen minutes. As to the effect the author says, "Whether this great over-exertion has been injurious to the accumulator, Messrs. Farbaky and Schenck do not state; but our experiments have shown that the cell can be discharged without injury at 200 ampères."

The author compares the performance of several types of cells, from which we get the following data: —

Farbaky and Schenck. — Capacity per pound of plate, 3.5 ampère hours; discharge-rate per pound, 2.1 ampères; total efficiency, 77 per cent (?).

Reckenzaun. — Capacity per pound of plate, 4.1 ampère hours; discharge-rate per pound, .37 of an ampère; total efficiency, 81 per cent.

Julien. — Capacity per pound of plate, 4.2 ampère hours; discharge-rate per pound, .42 of an ampère; total efficiency, 83.5 per cent.

Tudor (*at a practical discharge-rate*). — Capacity per pound of plate, 1.3 ampère hours; discharge-rate per pound, .33 of an ampère; total efficiency, 68.6 per cent.

These figures of Dr. von Waltenhofen for the Farbaky-Schenck accumulator mark an advance, and an advance that is in the right direction; but it is greatly to be regretted that the most important fact that is brought forward, namely, that the cells are not injured by such high discharge-rates, rests on a bare assertion, and no figures are given to show that a number of such discharges extending over a considerable period have been attempted.

NEW METHOD OF PRODUCING ELECTRIC CURRENTS. — C. Braun, in the *Berichte der Berliner Akademie*, describes a new method of producing electric currents. A wire of nickel is twisted into a spiral, and the two ends are connected with the terminals of a sensitive galvanometer. When the spiral is suddenly pulled out, there is a deflection of the galvanometer; and, when it is compressed, there is a deflection in the opposite direction. The direction of the current in a connected wire is determined by the direction of the twist as looked at from the end to which the wire is connected. It is stated that the effects cannot be accounted for by induction. A heating or cooling of the wire as a whole produces the same effects. If the wire is annealed, it loses its power of giving a current, but regains it again on being stretched. The effect is not large enough in diamagnetic bodies to be observed with any certainty. It seems to exist in iron and steel, but other effects make the observations difficult. If these effects exist at all, and are not due to induction, they are probably caused by the different strains on the outside and inside of a spire of the wire. It is stated that if the wire be magnetized the effect is greatly augmented.

SOME CURIOUS INCANDESCENT LAMP PHENOMENA. — The *Electrical World* publishes a letter from F. J. Crouch describing some curious effects obtained with incandescent lamps, both of whose terminals were joined to the circuit of an alternating-current dynamo. The circuit of the dynamo is made through a resistance of about 2,000 ohms (the electro-motive force is not stated). To the leads on one side of the resistance are attached both terminals of some Bernstein incandescent lamps, whose bulbs are immersed in tumblers of salt water. From the other side of the resistance, and therefore at a potential differing greatly from that of the lamps, wires are brought to the tumblers and dipped in the water. "Now, when the dynamo is started, the light appears, and the light-waves pass through the glass." The light is described as "similar to that of the glow-worm or firefly. With three Bernstein lamps, I obtained a beautiful moonlight effect, sufficient to read by in a large room." Another interesting phenomenon has been brought out in a series of letters to the same paper. It is found that incandescent lamps in the vicinity of belts or apparatus giving considerable statical discharges have a very short life. The writer has tried a few experiments to verify this. On holding near a Weston lamp (110 volts) the end of a wire connected with a Holtz machine, if the lamp be burning and the machine is turned rapidly, the filament will break in from one to five minutes. In the first lamp experimented on there was a very marked vibration of the filament, being more violent when the negative pole of the Holtz machine was presented. This lasted for perhaps a minute, when the filament broke. Some other lamps were experimented on in which there was no vibration of the filament that could be noticed; still they broke in a short time. The effect is of some practical importance in paper and other mills, and the life of the lamps can be greatly increased by putting over the bulb a wire netting connected with the earth. If the net be made of polished wire, — German silver, for instance, — there will be little or no loss of light.

BOOK-REVIEWS.

Literature in School. By HORACE E. SCUDDER. Boston and New York, Houghton, Mifflin, & Co. 16°. 15 cents.

OF the many reforms now being urged in school matters, one of the most commendable, and one which appeals to the best sense of the community, is that which urges the replacing of the literary mess now offered to the child in the usual school-reader by works of literature which have won for themselves a place. In this movement Mr. Horace E. Scudder of Cambridge has taken and is taking a leading part. Not only has he written forcibly and well on the subject, but he has himself prepared various editions of standard works fit for use in the school-room. In the present pamphlet Mr. Scudder prints his address on the subject of 'Literature in Common-School Education,' read before the National Education Association at its meeting in San Francisco in July last, and his two papers on 'Nursery Classics' and 'American Classics' respectively, which have recently appeared in the *Atlantic Monthly*. Mr. Scudder points out that literature has a field and an office of its own, and, unless it is recognized in the school, the place which it should take must remain unfilled. Literature gives expression to the spiritual and non-material wants of man, and must be brought into the foreground to counterbalance the tyranny of materialism, which bids fair, unless checked, to increase year by year. Mr. Scudder does not mean by the reading of literature in school the critical study of great authors. To urge that, would be to place a weapon in the hands of his opponents; but he says (p. 31), "The place, then, of literature in our common-school education, is in