cific virus which makes the latter gradually lose its pathogenic properties. This very supposition of adaptation underlies protective inoculation with attenuated specific fungi, as well as with dissolved specific products of decomposition.

INOCULATION AGAINST INFLAMMATION OF THE LUNGS IN CATTLE. — At the end of last year the Prussian minister of agriculture ordered experiments to be made on cattle, in order to decide the extremely important question whether inoculation affords protection against infectious inflammation of the lungs in cattle or not. These experiments, according to the *Lancet*, were carried out under the superintendence of Professor Schütz and the departmental veterinary surgeon Steffen, in the government district of Magdeburg, and have recently been finished. On Oct. 8 last, twelve young bulls were inoculated with fluid and particles from diseased lungs, — three with warm and three with cold fluid, three with warm and three with cold particles. Those inoculated with warm fluid contracted the disease most severely. On Oct. 26 all twelve, along with four uninoculated animals of the same age and breed, were placed among cattle suffering from infectious inflammation of the lungs, and their noses were repeatedly brought into the closest contact with those of the diseased animals for hours together. In December and in January all the animals were killed, and the post-mortem showed that the twelve inoculated animals had remained healthy, and that three of the four uninoculated ones had contracted the disease. The experiments were now repeated, special care being taken that all the animals (inoculated and uninoculated) were exposed to as nearly as possible equal degrees of infection, and that the fluid used for inoculation was taken warm from the lungs which had proved most effective. On Nov. 9 twelve young bulls were inoculated with different quantities (0.05 to 1.0 cubic centimetre) of warm lymph. The quantity of the fluid used did not affect the intensity of the local process. One bull died on the thirty-fifth day after inoculation, of peritonitis, caused by the spread of the inoculation process. On Dec. 1 the inoculated bulls were placed among bulls suffering from infectious inflammation of the lungs, but did not contract the disease. On Jan. 27 they were taken to another stall, and again placed among bulls suffering from the disease in question. On April 12 the eleven inoculated and two uninoculated bulls were inoculated with warm lymph between the neck and the breast, after which the two latter became severely ill, and one of them died. The previously inoculated animals, on the other hand, showed only slight symptoms at the place of inoculation. On April 12, twenty grams of warm lymph were mixed with 2,000 of warm sterilized flesh-broth, and sprayed before the nostrils of the inoculated animals. They remained healthy. On May 13 they were again placed among others which were suffering severely from the disease in question. After this, no morbid symptoms were observed in them. On June 26 one cubic centimetre of warm lymph was injected into the lungs of each of the inoculated and of two uninoculated bulls. The inoculated animals remained healthy, while the two uninoculated ones contracted the disease in a very severe form, and one of them died. At the end of July the inoculated animals were killed and dissected, and no abnormal developments were found. It therefore now seems to be proved that cattle inoculated with fresh warm lymph are protected against infectious inflammation of the lungs.

THE HEARING OF SCHOOL-CHILDREN. — Over nine thousand children have been examined in the schools of the following cities, — New York, Stuttgart, Bordeaux, Munich, and Glasgow, — and the average of defectively hearing pupils is 26 per cent plus. As a comparison test between children who were regarded as bright and those considered backward and dull scholars, teachers were requested to make a selection of seventy of each group. The results of the examination of the two sets, says the *British Medical Journal*, show twice as many with defective hearing among backward children as among the forward children. Some of the advice given to teachers would be, keep in mind the liability of existing impairment of hearing in the backward children. Children known to be suffering from defective hearing should be given seats nearer the teachers, and with their best ear towards the desk. When the defect is considerable or extreme, they should be taught in separate classes. All boxing of the ears of children should be stringently prohibited.

CONFECTIONERS' DISEASE. — A disease peculiar to confectioners has been recently observed in France. It occurs principally in persons engaged in the manufacture of candied fruits and *maron glacés* or candied chestnuts. Five cases observed by Dr. Albertin of Lyons, described in the *Gazette Hebdomadaire*, March 19, 1889, well illustrate the nature of the disease. The affection is restricted to the nails of the hands, and usually first makes its appearance at the sides of the nails, the periungual portion becoming loosened and raised up, the nail losing its polish and becoming black. In more advanced cases an inflamed swelling appears at the base of the nail. The nail is rough, scaly, and in some cases broken in several fragments, but is never cast off in its entirety. Finally the terminal phalanx also undergoes a change in form, and becomes flat and widened. In the earlier forms of the disease very little pain is experienced, and the patient is able to go on with his work. The disease disappears as soon as the work is discontinued, although a deformed nail and a flat or bent terminal phalanx are apt to remain. Albertin states that among the large number of candy-factories which he has visited, he has not found one in which from one to three workmen were not suffering with the disease. *The Medical and Surgical Reporter* suggests that the affection is caused by handling and working in the various substances employed in the manufacture of candies, among which are mallic, tartaric, and citric acids. The hands are also alternately in cold and hot liquids; and this, as well as the manipulation of the preparations, by means of which the irritating substances find their way under the nails, may be regarded as causative factors. It would be interesting to know whether this disease exists in this country, where the manufacture of candies is so extensive.

CURIOUS TRANSMISSION OF SCARLET-FEVER. — The *Boston Post* is responsible for the story that in 1846 a boy eight years old was taken down with scarlet-fever, and died. One of the principal amusements of his illness had been looking over a large picture-book. After his death, this, with several other useful playthings, was packed away in a trunk. Twenty-six years later, in 1872, the trunk was taken to England. The trunk was opened the second day after its arrival, and the picture-book was taken out and presented to a boy two years old. During the next fortnight the little fellow was attacked with scarlet-fever. It was a wonder to the doctors who were called in consultation how the disease had been contracted, as there had been no scarlet-fever in the town for years. At last it was suggested that the picture-book might have transmitted the disease; and the medical men in attendance, on being told the facts connected with it, agreed that it had retained the poison for twenty-six years, and then communicated it to the child. This appears, says *The Medical and Surgical Reporter*, to be one of the instances in which scarlet-fever from some unknown source developed coincidently with the handling of articles used by a patient who had the disease many years before.

MENTAL SCIENCE.

Mental Activity in Relation to Pulse and Respiration.

THAT the blood circulation in the brain is an important factor in its healthy activity, and that the intermittent supply of the same recorded by the pulse, and the intermittent purification of the blood by the lungs in breathing, must also play important parts in the maintenance of mental action, are admitted by all physiologists, though our knowledge of the precise nature of these influences is very limited. Professor Leumann of Strassburg (*Philosophische Studien*, v. No. 4) calls attention to the necessity of noting the pulse and respiration rates in psychological experiments; and, though he gives but few positive results, his treatment of the topic is highly suggestive.

Such general observations as that when out of breath, owing to running or severe exertion, not only articulation but the words themselves fail one; that in drowsiness or sleep both pulse and respiration are slackened, — indicate the connections of the two functions. Again, these rhythms make themselves felt in such ac-

tions as dancing, scanning, and even the fluctuations of sensation. For example: a star just visible to the eye fades away and reappears. The intervals of this attention wave have been measured, and, according to one observer, are from 2.5 to 3 seconds for sensations of electrical shock, 3 to 3.4 seconds for light sensations, and 3.5 to 4 seconds for sensations of hearing; or 24 to 20, 20 to 18, and 17 to 15 fluctuations per minute, — a rate strikingly similar to the rate of breathing. It would be interesting to find whether these sensation "waves" vary essentially in persons with abnormally high or low respiration rates. Again, the relation of the rate of scanning to pulse and respiration may be tested. One subject, when his pulse tells 77 per minute, reads 113 feet per minute, but, with a pulse of 83, reads 140. Individual differences in pulse and respiration may affect the normal rate of reading. One subject, with a pulse of 86 and a respiration of 26 per minute, makes 55 double steps, and reads 126 trochaic feet, in a minute; while another, with a pulse of 66 and a respiration of 22, makes 51 steps and reads 120 feet in the same time. Verse-reading in schools might be similarly tested. In a preliminary test a pupil with a pulse of 85 read 107 feet per minute, another with a pulse of 98 read 129.

In one case Professor Leumann made a distinct test, measuring the pulse at frequent intervals, and also the rate of scannings as the subject was reading. Comparing the rates before an intermission with those after, he finds an almost exact correspondence of scanning rapidity with pulse rate. When 40.1 feet are read per minute, the pulse is $85\frac{2}{3}$; when 38.8 feet are read, the pulse is $82\frac{1}{3}$.

It is noteworthy, too, that a large range of association times varies between .7 and .8 of a second, — the period of a normal pulse-beat. In reproducing time intervals, the period reproduced with least error is also this same period. These, however, are mere suggestions. The outcome of the paper is to accentuate the importance of noting these physiological conditions when studying psychic phenomena, and particularly when making time measurements of them.

DISTANCE AND SIZE. — One of the most vexed questions of psychological optics relates to the inference of distance when the size of an object is known, or the inference of size when the distance is known. Psychologists are agreed that the process is not immediately given in sensation, but the result of experience. The young infant reaches for things entirely beyond its grasp. Under ordinary circumstances, our inferences of size, though unconsciously performed, are extremely complicated. The estimation of half a dozen different kinds of perspective, together with what real knowledge we have of the sizes of the objects in question, enters into the result. To study the question scientifically, we must arrange the observation so as to exclude all but a single variable. When this can be done, as, for example, in the gradual removal of an object from the eye, under proper conditions, the general assumption has been that the result depends on the size of the retinal image, or by the angle made at the centre of the eye by the extreme contours of the object. In the last number of the *Philosophische Studien* (vol. v. No. 4), Dr. Götz Martius describes a few experiments that lead him to question the correctness of this view. At a constant distance of 50 centimetres from the eye of the observer he placed a rod 20, 50, or 100 centimetres long. At a much greater distance (either $2\frac{1}{2}$ or $5\frac{1}{4}$ metres) he had a variety of rods, differing from one another slightly in length only. Both were viewed against a continuous and uniform brown background, and the problem of the observer was to judge when the distant rod seemed equal in size to the near one. Even here the fact that we are accustomed to interpret the far in terms of the near, and pay attention only to estimating the actual size of the object, makes it difficult to separate judgment and impression; to answer, not whether, if the distant rod were brought side by side with the near one, it would be equal to it in length, but whether the retinal impressions of the two as they are seem the same. After a little practice, this can be done, though the result does not point to a definite length, but to a narrow range of lengths any one of which seems equal to the near rod. Taking the average values, one observer, with 5.25 metres between the two rods, judges the distant rods of 21.67 centimetres, of 57.62 centimetres, and of 106.62 centimetres to be equal to near rods of 20, 50, and 100 centimetres: at 2.50 metres between the rods, the former lengths become 20.62 centimetres, 53.87 centimetres, and 107.75 centimetres. Similar results for Dr. Martius are 21.92 centimetres, 59 centimetres, 110 centimetres, and 21.62 centimetres, 56.62 centimetres, and 109.25 centimetres. What these figures show, apart from the facts that such observations are possible and that the result varies with the individual, is that a distant object, to seem equal to a near one, increases in size with the distance, but increases very slowly; much slower, that is, than the visual angle decreases. It is probable, too, at the same difference of distance, the ratio between near and distant objects of various sizes remains constant. The result requires further corroboration and extension, but, even as it is, is important in rendering improbable the usual view of the matter.

SENSIBILITY TO TONE INTERVALS. — The ear has been called the mathematical sense, because the perception of musical interval involves the nicest appreciation of definite numerical relations between the vibration rates of the tones forming the interval. The very slight deviations from a true interval recognized as such by skilled musicians, which Helmholtz has satisfactorily explained as due to the relations of the overtones of the two tones, shows us that the interval sensibility must be very fine. The accurate determination of this sensibility for the various intervals has been attempted by a few methods, but with results individually different, and containing sources of error. The whole topic has been rigorously re-investigated by Iwan Schischmánow in the psychological laboratory at Leipzig (*Philosophische Studien*, v. No. 4). The method consisted in adjusting a movable weight on a tuning-fork until (1) it just formed a certain interval with a constant fork, (2) it just appreciably diverged from it above, and (3) just appreciably diverged from it below. The results are then grouped, and an average formed, expressing in fractions of a vibration per second the difference between the vibration rate of the true interval and the tone just distinguishable as not a true interval. For two observers, S and K, of whom S is a good amateur musician and K is not musical, the results thus expressed were as follows: for the octave whose ratio is 2 : 1, S 0.220, K 0.356; the fifth (ratio 3 : 2), S 0.332, K 0.374; the fourth (ratio 4 : 3), S 0.419, K 0.403; the third (ratio 5 : 4), S 0.485, K 0.559; major sixth (ratio 5 : 3), S 0.502, K 0.506; the second (ratio 9 : 8), S 0.548, K 0.716; minor third (ratio 6 : 5), S 0.607, K 0.640; minor sixth (ratio 8 : 5), S 0.672, K 0.740; minor seventh (ratio 9 : 5), S 0.678, K 0.763; major seventh (ratio 15 : 8), S 0.861, K 0.902. A comparison of these with former results leads to the conclusion that practise and individual traits contribute to the result, but that in general the order of delicacy of the various intervals as shown by S, especially the order of the four "best" and the "worst" perceived intervals, may be taken as fairly normal. This order corresponds nearly with that elaborated by Helmholtz on the basis of relative consonance of overtones, but it shows that perceptions of intervals are possible without such an aid. The numbers show, too, the great accuracy of the sense of musical interval. Another result is that the sensibility for the lowering of an interval is finer than for an increase of the interval, though it must be noted that the variable tone in these experiments was always lower than the constant tone.

ELECTRICAL NEWS.

Siemens's Five-Lead System.

THE municipal authorities of Königsberg, in Prussia, in conjunction with the representatives of the citizens, resolved this spring to carry out, at their own expense, an electric central station for the town, which was calculated for a supply of 30,000 16-candle glow-lamps, though arrangements are to be made at first for 8,000 lamps. The entire installation, as it is now about to be executed, merits the attention of the entire electro-technical world, and of all persons interested. A correspondent of the London *Electrical Review*, therefore, briefly gives the chief points which will be brought forward in executing the installation. The current will be supplied from four groups of slow-speed dynamos, arranged in series, and connected directly with the steam-engine. Between these dynamos and the conducting net there is placed a battery of