throughout the country. On the contrary, the genius of the Anglo-Saxon race leans towards self-help. It has been the mission of the race in the past to develop self-government in religion and politics: it remains to crown this work with the application of the voluntary system to liberal education.

In indulging this piece of speculation I have had a practical purpose before me. If what I have described be a reasonable forecast for the university of the future, does it not follow that university extension, as the germ of it, presents a field for the very highest academic ambition? To my mind, it appears that existing types of university have reached a point where further development in the same direction would mean decline. In English universities the ideal is "scholarship." Scholarship is a good thing, and we produce it. But the system which turns out a few good scholars every year passes over the heads of the great mass of university students without having awakened them to any intellectual life: the universities are scholarship-factories, producing good articles, but with a terrible waste of raw material. The other main type of university enthrones "research" as its *summum bonum*. Possibly research is as good a purpose as a man can set before him, but it is not the sole aim in life. And when one contemplates the band of recruits added each year to the army of investigators, and the choice of ever minuter fields — not to say lanes and alleys — of research, one is led to doubt whether research is not one of the disintegrating forces of society, and whether ever-increasing specialization must not mean a perpetual narrowing of human sympathies in the intellectual leaders of mankind. Both types of university appear to me to present the phenomena of a country suffering from the effects of over-production, where the energies of workers had been concentrated upon adding to the sum of wealth, and all too little attention had been given to the distribution of that wealth through the different ranks of the community. Just at this point the university extension movement appears to recall academic energy from production to distribution, suggesting that devotion to physics, economics, art, can be just as truly shown by raising new classes of the people to an interest in physical and economic and æsthetic pursuits as by adding to the discoveries of science, or increasing the mass of art products. To the young graduate, conscious that he has fairly mastered the teaching of the past, and that he has within him powers to make advances, I would suggest the question whether, even for the highest powers, there is any worthier field than to work through university extension towards the university of the future.

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## LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

*The editor will be glad to publish any queries consonant with the character of the journal.*

*On request, twenty copies of the number containing his communication will be furnished free to any correspondent.*

### The Souring of Milk during Thunder-Storms.

IN *Science* of Sept. 19, 1890, appeared a short note on some work recently done in Italy by Professor Tolomei on the souring of milk during thunder-storms. Professor Tolomei concludes that there is a sufficient amount of ozone generated at such times to coagulate milk by a process of direct oxidation, and a consequent production of lactic acid.[1]

Similar results have been obtained by other experimenters, and some have even gone so far as to say that free oxygen, when in contact with milk, will generate enough lactic acid to coagulate its caseine.

These results are very different from some obtained in this laboratory. While working on the bacteria in milk, the idea occurred to us to find out, if possible, the truth of the somewhat widely accepted theory that milk will sour with extreme rapidity during thunder-storms. Although the statement that this is an oxidizing action had been frequently made, a Mr. Iles of Baltimore was the first, so far as I know, to perform any experiments in this direction.[1] His method was to subject milk to the action of ozone, generated by an electric spark passed through oxygen, above the milk. He found a rapid coagulation produced, which he attributed to the direct oxidizing action of the ozone.

Our method was similar to that of Mr. Iles's. A Wolff bottle was filled about one-third full of milk, and the air in the bottle displaced by pure oxygen. Through the opposite necks wires leading from a Holtz induction machine were passed into the interior, and the necks plugged tightly with cotton to prevent any escape of oxygen; ozone was then generated by passing a spark across through the oxygen from one pole to the other. In some cases, instead of the spark, a "silent discharge" of electricity from the two poles was used to generate ozone.

In all cases a second bottle was partially filled with milk, and kept as a "control;" i.e., one in which the milk is left in its normal condition.

For some of our experiments three bottles were used, — one left as a control; a second filled with milk and oxygen; while a third was filled, like the second, with milk and oxygen, and then treated with the electricity. We thus had milk under three conditions: 1. In its normal state; 2. Under the influence of free oxygen; 3. Under the influence of free oxygen plus a certain amount of ozone. The electricity, in all cases, was passed through the oxygen for at least half an hour. That a considerable quantity of ozone was generated, was shown by its odor, and strong action on starch-iodine paper. Our results were very different from those given by Iles and Tolomei. The milk treated with ozone, or simply pure oxygen, soured a little, but only a little, faster than normal milk. If the milk in the control coagulated in thirty-six hours, the milk experimented on coagulated only an hour or two earlier.

This result was very constant. In a considerable number of experiments, using milk of all degrees of sweetness, from that just from the cow to that a day or more old, the same result followed, — a slight hastening of the time of coagulation in milk treated with ozone or oxygen. Between the time of coagulation of milk treated simply with oxygen, and that treated with oxygen plus ozone, no perceptible difference could be noticed.

We had, then, in our experiments, produced a slight hastening of the time of coagulation. Was this a direct oxidation? From the fact that it required over a day to act, it seemed likely that it could not be. If, however, it were an oxidation, it ought to act as well on sterilized milk — i.e., milk in which all bacteria have been killed by heat — as on ordinary milk. We therefore, before introducing the oxygen, sterilized the milk. In this case no coagulation occurred. Milk that had been treated at two separate times, a week apart, with oxygen and ozone, was kept for over two months without the appearance of the least sign of coagulation.

Briefly summed up, then, our results were as follows :—

1. Milk, under the influence of oxygen, or oxygen and ozone, coagulates somewhat earlier than when left in its normal condition.

2. This action does not take place if the milk has been sterilized, and is kept from contact with unfiltered air.

3. It is probably, therefore, not an oxidation. The conclusion drawn from this is that the souring was simply produced by an unusually rapid growth of bacteria. The bacteria of milk are mostly aerobic, and would undoubtedly be stimulated to rapid growth by free oxygen or ozone.

If in a thunder-storm ozone is set free, as some observers claim, its action on bacteria would perhaps explain the effects produced

[1] A more extended account of Professor Tolomei's experiments is given in *Biedermann's Central-Blatt für Agriculturchemie*, 1890, p. 538.

[1] Chemical News, vol. xxxvi. p. 237.

at such times. I am inclined to think, however, that a more probable reason is to be found in the general conditions of the atmosphere preceding and during the storm. It has been found in our laboratory that bacteria growing on gelatine will multiply with unusual rapidity during warm, sultry weather. Now, these are the atmospheric conditions that usually precede and accompany thunder-storms. It seems to me most likely, therefore, that whatever rapid souring occurs is due to an unusually rapid growth of bacteria, caused by especially favorable conditions of the atmosphere.

The experience of the proprietor of a neighboring creamery confirms to a certain extent these conclusions. He finds, that, if milk is kept at a uniformly low temperature during the thunder-storm season, no trouble results from rapid souring, indicating that this souring, when it occurs, is due more to a high temperature and sultry atmosphere than to the ozone in the air. If this were a process of direct oxidation, it should take place, partially at least, at the lower temperature.

Professor Tolomei finds, also, that a slight electric current, if less than three ampères, will have a preservative effect on milk, the current being passed directly through the liquid. A current greater than three ampères will decompose the milk.

In our experiments, a current of less than one-fortieth of an ampère was sufficient to produce decomposition, with a certain amount of coagulation at each electrode. A stronger current would produce complete coagulation, with the somewhat curious result that the coagulum was strongly acid at the positive pole, and more feebly alkaline at the negative pole.

AARON L. TREADWELL.

Wesleyan University,
Middletown, Conn., March 20.

### Mixed Races.

DR. F. VON LUSCHAN, in his description of the Tachtadschy (*Reisen in Lykien*, etc., Vienna, 1889), calls attention to the important fact that the Greeks of Lycia represent a mixture of two distinct types, and from these facts draws the following inference: "At first glance, it appears remarkable and hardly probable that two disparate types should remain distinct, although intermarriage has continued without interruption through thousands of years. But we must acknowledge that it would be just as remarkable if continued intercrossing should result in the production of a middle type (*Mischform*). It is true that at the present time the greater number of anthropologists appear to be of the opinion that middle forms originate wherever two distinct types live in close contact for a long time. If this is true at all, it is true only in a very limited sense, and still needs to be proven. *A priori*, we rather ought to expect that one or the other of these types would soon succumb in the struggle for existence. It would become extinct, and give way to the other type; or both types might continue to co-exist, although intercrossing might go on for centuries. They would undergo no other changes than those which each singly, uninfluenced by the other, would have undergone by the agency of physical causes." He exemplifies these opinions by statistical treatment of his cranial material, and by showing that in a single family all the extreme types which occur among the whole people are found.

Measurements of mixed Indian types give results which tally exactly with Dr. Von Luschan's views, and tend to support Kollmann's conclusions regarding the stability of cranial forms. The Bilqula (Bella Coola) of British Columbia are a mixed people, their language showing that they are of Salish affinity, while they have intermarried extensively with Athapascans and Haeltzukans. A study of the distribution of occurrence of length-width indices of their heads shows that the indices of from 79 to 81 are frequent, those about 83 rare, those of from 85 to 87 again very frequent. The first index corresponds to the most frequent one of the Haeltzukans; the last, to the most frequent one of the Athapascans of this region. If we consider the facial indices, a similar relation reveals itself. We find a greater frequency of the indices ranging about 79, a few cases ranging about 82, and many about 85. The height of body shows the same character of distribution, — a maximum about 160 centimetres, and another about 168 centimetres. If the three curves of frequency are drawn out, their correspondence is found to be so close that it cannot be due to mere accident. Other measurements do not show the same peculiarity, because those of the peoples of the coast do not differ materially from those of the peoples of the interior.

When these same curves are drawn out for the Oregonian Athapascans, it appears that the curves are also alike among themselves, while they differ fundamentally from those of the Bilqula. I give here a table of the length-width indices of the heads of the Oregonian Athapascans, Northern Californians, and crosses between the two, which will be found instructive: —

| | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oregonian Athapascans | 1 | 1 | – | 3 | 2 | 5 | 5 | 5 | 5 | 5 | 9 | 5 | 2 | 1 | 3 | 4 | 1 |
| Crosses | – | – | 1 | – | 1 | 1 | – | – | – | – | 1 | – | 1 | – | 1 | – | – |
| Northern Californians | – | – | – | 1 | 2 | 2 | 2 | 1 | – | – | – | – | – | – | – | – | – |

The first column shows particularly a much slower increase than we ought to expect if it represented a simple error curve; the second column shows a great variability, due to the presence of two distinct types. We see, notwithstanding the small number of cases, the maxima of the first and of the third columns clearly indicated. The asymmetry of the first column is easily explainable on the assumption of an intermixture with Californian tribes, and that therefore the indices peculiar to them occur more frequently.

On studying the single cases of these groups, it appears, that, although the characteristics of the component types become apparent by a statistical treatment of the series, they do not exist in the individual. The individuals are not representatives of one of the parent types, but mixed types; some parts of their bodies representing one type, other parts the other type. This mixture appears in a great variety of combinations. Middle types, that is, those standing between the two parent types, if found at all, are very few in number.

FRANZ BOAS.

Clark University, Worcester, Mass., March 17.

## BOOK-REVIEWS.

*Outlines of Psychology.* By HARALD HÖFFDING. Tr. by Mary E. Lowndes. New York, Macmillan. 12°. $1.50.

THE translation of this work has not been made from the original Danish, but from the German translation. Professor Höffding, however, considers the German version a correct and adequate representation of the original, so that English readers can here obtain an accurate account of his views. The English version is natural and easy, and the author's meaning is, as a rule, plain and intelligible. The work is written with ability, and gives evidence of prolonged study of the subject in all its departments. It opens with some account of the scope and method of psychology, followed by a chapter on the relations of mind and body, and then takes up in succession the three fundamental elements of mental life, — cognition, feeling, and will, — the first of them naturally receiving the principal share of attention. The work is designed as a manual for students; but for that purpose the arrangement is bad, since the earlier chapters can hardly be understood without some previous knowledge of both psychology and philosophy. The plainness of the author's style, however, serves partly to remove this difficulty.

As regards the substance of the work, our judgment must be rather unfavorable. Professor Höffding's philosophical standpoint is that of the association school, modified somewhat by evolutionism, yet not differing essentially from that of the English writers with whom we are familiar. He attempts, indeed, to treat his subject without reference to philosophical theories, stating at the outset that psychology is a purely empirical science in no way dependent on metaphysics; yet he is not able to adhere to this position, but drops into philosophical discussion at intervals