haps, from what follows, I should say, in trying to teach the biological sciences, one is apt to have had experience with various types of student mentality and to have learned something of the intricate cerebrations of student aspirants to wisdom.

One can expect a certain amount of misspelling of scientific terms, such as "Senterpede; Bile Ducks; Liver fruit (flukes)," and so forth. These will always occur under the present system of teaching spelling in the lower schools.

Looking over a list of choice and rare gems of student misinformation evidenced in written answers, which has been gleaned from actual test papers during a long period, the following actual answers would seem to have been faked, or to be the lucubrations of a disordered imagination.

The following are among the more amazing:

Enzymes are plants having hairs that are inactive; such as cactus and onion.

Root-tubercle bacteria attack the roots, causing them to die, and it is due to the decay of layer or top of layer of plants and vegetable matter that causes the production of fuel.

By metamorphosis is meant the change in form which takes place in animals in whose life history metamorphosis takes place.

Pollination is a process by which the ovary of the stamen is fertilized by the pollen which comes from the *antlers*.

Malaria is caused by a certain kind of mosquito, and in a little while he has yellow fever. Of course every kind of louse does not carry yellow fever.

Sporozoa is a disease caused by certain forms of bacteria.

Birds have one antiseptic kondyle (Occipital condyle).

An antiseptic is something that prevents or stamps out fumigation.

Bacteria are used when vaccinating a person for disease; again they are used in spraying plants.

Vertebrates are mammals or man, such as birds, lizards, reptiles, snakes, fish, whales.

A notochord is an animal that has not a backbone.

Arthropods have the nerve system on the Bellephloem (Belly floor?).

A metamorphosis is a sucking insect and is very injurious to trees.

Placenta is center of some animal element which is surrounded by some more of animal substance not as vital as it.

An insect is a vertebrate and invertebrate animal, having no true back bone.

Liver-flukes attack the tail of the animal, which excited, moves its tail; this is kept up until finally the tail falls off.

Chinch-bugs may be controlled by use of carbon bisulphide gas on the outer rows of a corn field.

Reptiles have two or more pairs of limbs, such as the locust and others.

O Tempora, O Mores!

ELLISON A. SMYTH, JR.

THE SCIENTIST AND AN INTERNATIONAL LANGUAGE

IN the current (June 20) issue of SCIENCE I have noted the communication of Dr. Roland G. Kent on "The scientist and an international language." The need for an international language is great both in science and in other fields. It is perhaps possible to conceive that the translation of articles upon scientific subjects into Latin would be relatively easy for a very few men, but for most of us such a thing would constitute a *tour de force*, in fact a practical impossibility, even assuming that we had at hand an adequate "unabridged" English-Latin dictionary of modern scientific and technical expressions.

To express modern ideas in Latin requires exceedingly ingenious, not to say clumsy, circumlocutions. The technical dictionaries in the vernacular are always far behind the daily and common use of technical and scientific expressions and the best dictionaries contain but a portion of the technical terms. As an example I might cite the fact that nearly half of the 1,200 milling and baking terms which I have compiled are not found in "Webster" or the "Standard."

A Latin glossary is perhaps possible for sciences like botany, and without doubt a commission could translate or transliterate most of our modern chemical terms, but it would not be quite so feasible in the social sciences and would certainly be difficult in the mechanical arts. In high school and university I devoted five years to Latin, one year to Greek and four years to German, also taking a little French and Spanish, yet I should certainly hopelessly fall down if the task were given me to describe in Latin a walk around Lake Calhoun, let alone writing an article on measurement of viscosity or talking to a foreign chemist regarding the specific rotatory power of a soluble carbohydrate.

In scientific work we could not get along without modern scientific equipment such as pyrex and silica glass, dictaphones and audion valves, and it is certainly not in line with progress or convenience to think of going back to antiquated modes of expression even though that could be accomplished. We have gone beyond the Roman notation and adopted the very simple and easier Arabic notation. We have adopted universal musical notation and have nearly come to full use of the metric system. Why should we hesitate to adopt Esperanto, which nearly if not completely possesses every desired quality which an international language should possess?

Dr. Kent asserts that any artificial language can not convey the thought with objective certainty, but that Latin is unsurpassed in this respect. I have for many years made the most practical use of Esperanto in gathering scientific information from non-scien-

tific and scientific men in all quarters of the globe and wish to say that I have found it capable of expressing with exactness shades of meaning which one finds difficult to express in English. The ability of the Greek in this particular is only surpassed by Esperanto with its highly ingenious prefix and suffix system in forming readily understood yet exactly defined expressions.

It was not necessary for me when first I happened on the word "disaudigi" to understand that it meant "to broadcast": *dis*—in different directions, *aud*—hear, *igi*—to cause to. Esperanto has been termed modernized and simplified Latin and "the least common multiple of the European languages." It is not in the true sense an artificial language. Probably 75 per cent. of the roots are of Latin origin, and the very simplicity of the grammar constitutes the best argument for its use as a scientific tool. It is not the words and names that make a language difficult but the grammatical gender, the idiomatic expressions, the similarity of case and verb endings, etc. The grammatical construction of Esperanto is easily mastered by any intelligent person in an hour's study.

Consider for a moment the complications of Latin inflections, for instance, the ending *is* in nouns and adjectives in the dative and ablative plural of the first and second declensions, the genitive singular and many nominative and vocative singulars and accusative plurals of the third declension, occasional genitives in the fourth declension; in verbs many second person singulars and most second person plurals; also a number of adverbs.

The Committee Appointed to Inquire into the Practicability of an International Auxiliary Language of the British Association for the Advancement of Science favored Esperanto and named the disadvantages of Latin. The American Association would do well in its efforts for the advancement of science to follow the lead of the British, French and Italian Associations, the first Pan-American Scientific Congress in 1909, the World Union of International Associations, and numerous other commercial and international organizations and the Central Office of the League of Nations, by endorsing and making use of Esperanto for the purposes for which Dr. Kent proposes Latin.

If difficulties exist they are certainly minor ones which can be overcome, and the point must not be lost sight of that the purpose of an international language is to gain quickly and exactly the information presented by a writer. This will be the more easily possible if the writer expresses his thoughts clearly and simply, and it is a pleasure to assure those who have not used Esperanto that it is an easily used tool of exceeding sharpness and accuracy to which one quickly becomes accustomed. Those who have attended international congresses where Esperanto has been used have always commented on the fluent speech and the obvious understanding which existed, and the smoothness of the transactions in contrast with the tedious proceedings and interruptions for translation at congresses using several national languages.

We might perhaps compare the use of Latin, German and Esperanto in the translation of an article to the comparative pleasure that would be experienced in attempting to drive a wind-broken nag, a 1907 model auto and a 1924 six or eight cylinder coupé on a twenty-five mile trip.

CHARLES H. BRIGGS
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I HAVE seen the letter of Mr. Charles H. Briggs, of Minneapolis, regarding my recent communication on "The scientist and an international language," and desire to make a brief reply.

The difficulty with the use of Latin as the international language for the scientist is not that which is mentioned by Mr. Briggs, but the fact that the budding scientists have not been brought to the study of Latin with the idea that it will in the future be their medium of international communication. If such an attitude had been inculcated, we should see to-day very different results from the study of Latin and should find many more scientists glad to accept the services of the Latin language.

Mr. Briggs's own statement that "probably 75 per cent. of the roots (of Esperanto) are of Latin origin" virtually concedes the case in favor of Latin, in the matter of vocabulary. As for ease of word formation, nearly all the suffixes of Esperanto which form nouns and adjectives, and most of the other formative elements, are taken direct from Latin or from Greek, and are as easily usable in Latin as in Esperanto. It is clear to any one familiar with etymologies that virtually all technical vocabularies in English are of almost exclusively Latin and Greek origin. Probably all of them are, without exception, but from scholarly caution I insert the *virtually*. It happens that I do not know the terminology of milling and baking, but I should be very glad to make an etymological analysis of it, if it should be submitted to me. And while I admit that I could not write in Latin a technical treatise on milling and baking, nor on most other natural scientific subjects, I could not do it in English either. Yet I can see what the Latin would be for the "specific rotatory power of a soluble carbohydrate," since every word is already Latin except the *hydr*, which is Greek and can be used freely in Latin; and as for a walk around Lake Calhoun, I shall be pleased at any time to demonstrate the ease with which it can be described in Latin, if Mr. Briggs will furnish me with the English text: the lake is unknown to me personally.

The other differences between Mr. Briggs and myself are matters of opinion. But in considering them, one must not forget that the Esperantist has almost always approached the study of Esperanto with a considerable previous study of other languages, sufficient to render language study easy to him, and with an enthusiasm raised to a high pitch by repeated assurances that Esperanto is extremely easy. Professor R. A. Muttkowski develops this theme very effectively in *America* for December 30, 1922. But of these two factors, the former is not intrinsic in Esperanto, and the second is extraneously stimulated. Grant the same mental attitude toward Latin or toward any other language as that which has been developed toward Esperanto by its advocates, and the rate of progress would be enormously accelerated. But this is not normal. One may note that Professor Leskien, the great linguist and philologist of Leipzig, found it very difficult to gain a mastery of Esperanto, though he devoted several hours a day to it for three months, and he was a man who spoke a number of modern languages, including several Slavonic languages, which are reputed to be very hard to learn.

ROLAND G. KENT

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SCIENTIFIC APPARATUS AND METHODS

ARTIFICIAL CULTIVATION OF FREE-LIVING NEMATODES

THE artificial propagation in pure culture of microscopic organisms, wherever it has been successfully applied, has opened the road to discoveries of the most important and most diversified kinds. The development of cultural methods for the study of bacteria by Pasteur will always stand as one of the important milestones in the progress of bacteriological science. Since Pasteur's time numerous refinements have been made in cultural methods, particularly the introduction of solid media by Koch, and great extensions have been made in the application of this method of study to organisms other than bacteria and fungi. Spirochetes, free-living protozoa, trypanosomes, Leishmaniae, intestinal flagellates and even malarial parasites have been successfully grown in culture, either pure or in conjunction with organisms on which they feed.

So far as I am aware the propagation in pure culture (pure as far as metazoan species are concerned) on artificial media of free-living nematodes has not previously been recorded. I recently made the discovery that certain species of free-living nematodes would thrive and multiply at an astounding rate on ordinary nutrient agar plates. A single isolated adult female of Rhabditis sp., placed on an agar plate with a drop or two of dirty water to supply a bacterial growth, in a period of five days produced hundreds of offspring which swarmed all over the plate. In ten days the offspring numbered many thousands—males, females, eggs and young in all stages of development. The majority of the individuals are found moving about on the surface of the agar, but some burrow into it also. The movements on the agar are sufficiently impeded so that they can be watched after the fashion of a slow-moving picture. The swallowing of bacteria and fungus spores, the excretion of waste matter from the anus, and every detail of locomotion can be observed under ideal conditions. I have succeeded in culturing at least two different species of Rhabditis, a Cephalobus and others which are not positively identified. A pure culture, *i.e.*, a culture containing only one nematode species, seems to develop more rapidly than a mixed culture.

Cultivation of free-living nematodes in this manner suggests a great range of possibilities in the way of study and experimentation, *e.g.*, on foods, effects of hydrogen ion concentrations and of chemical substances, resistance to desiccation, tropisms, effect of various modifications in environment on rate of reproduction and development, etc. In the case of beneficial or injurious species, it might lead to the discovery of methods for controlling or encouraging them. The extremely rapid rate of reproduction and ready inbreeding suggests great possibilities in the way of genetic experiments.

Cultivation on agar plates also furnishes a convenient method of obtaining large quantities of material for taxonomic study, in all stages of development. A drop or two of water washed over the surface of the plate and then placed on a slide with a little ether gives a large number of perfectly clean nematodes for microscopic examination.

For class demonstration the cultivation of the soil nematodes on agar plates is ideal. If a student places a small quantity of soil, especially manured soil, in a piece of gauze or in a fine sieve, and washes it in a beaker of water of about 100° F., for a few minutes, the majority of the nematodes present will fall to the bottom of the beaker. A drop or two of water from the bottom of the beaker is placed on the surface of the agar, the plate is covered and left at room temperature for a week or two and then examined under a microscope. I can guarantee from personal experience that the result will be startling.

Further investigation on the cultivation of these nematodes, especially its application to a larger number of species, had been planned before publishing the work, but an unexpected change in my plans makes it improbable that it can be continued for some