ample may serve to indicate the kind of pitfall one may step into in trying to force a sophisticated language like Greek into an artificial pattern.

Further, I notice that in certain cases in which the Greek noun could not be latinized, the genitive form of the noun has been changed, regardless of the confusion this entails. On page 262, for instance, we read that the family name Chlamydobacteriaciae derives from the Greek noun *chlamys, chlamydis* (cloak). In fact, this family name derives from the real genitive of this Greek noun, which is *chlamydos*—hence *Chlamydo-*, and not *Chlamydi-*bacteriaceae. The genitive form of the Greek nouns belonging to the third declension, such as *chlamys*, serves as the root of words derived from these nouns. Any change of the original genitive form, therefore, leads to confusion.

As a result of the procedure discussed here, the Greek nouns *bios* (life) and *zōon* (animal), from which derive many everyday English terms such as "biology," "biochemistry," "zoology," and "protozoon," are deformed into *bius* and *zōum*. The fallaciousness of the procedure could not be more clearly illustrated than in the case of the name *Peptostreptococcus micros*. On page 537, with reference to this name, the real Greek adjective *micros* (small) is explained as deriving from the made-up "Greek" adjective *micrus*.

In summary, the procedure of transliteration applied in the current edition of *Bergey's Manual* may be characterized as an arbitrary mass latinization of Greek words that puzzles the proficient and perplexes the uninstructed.

Fortunately, there is an easy way to remedy the situation, and that is reversion to the system applied in the preceding, 6th edition of the *Manual*. This is the system used in the standard English dictionaries.

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Electro-Magnetics of Matter

Transistors and telescopes have a lot in common. Our modern culture depends heavily upon our use of myriads of gadgets—gadgets which often depend in turn upon the interaction of matter with electric or magnetic fields. It is my belief that our present educational arrangements leave a wide gap and do not adequately prepare our college graduates to deal with this situation. I intend to show that this gap can and should be filled, preferably and simply by giving deserved emphasis to a broad discipline which one may term the "electromagnetics of matter."

I submit that a proper function of an education is to prepare the student to enter his contemporary culture well prepared both to participate in and to develop it. Centuries ago it was sufficient, for example, to study history, philosophy, the arts, several "universal" scholarly languages such as Latin or Greek, and a smattering of mathematics, and the individual emerged rather well equipped to grapple with the then current culture. Since then, the times have witnessed large advances in the scientific areas of our culture. Therefore, a well-educated person must also possess at least a modicum of understanding of science to fit the modern culture. Similarly, the present-day scientist or engineer needs to be well acquainted with the fundamentals of all presently useful branches of scientific knowledge. Since so great a number of our present-day machines, the substructure of our modern culture, depend upon the interaction of matter with electro-magnetic fields, it appears to me that we must not minimize that aspect of our education, at least in educating scientists and engineers.

The gadgets of our civilization which depend upon the interaction of matter with electric and magnetic fields are numerous. Consider the transistor, the resistor, semiconductors, photoconductors, insulators, crystal microphones, regular electric lights, fluorescent lights, neon lights, x-ray machines, magnets, large computers, thermocouples, electric wiring, electric motors, and telescopes, to name a few. The electrical and magnetic properties of our earth, the ionosphere, and the Van Allen belts are important in this age of space. Plasmas such as the ionosphere, the Van Allen belts, the sun, and the stars are of great importance in our dealings with nature. Diverse as all these are, there is an underlying interconnection, for all obey the laws of quantum mechanics and all are manifestations of the effects of electromagnetism upon matter. It would seem wasteful, educationally speaking, to treat each item as a separate, special case and to neglect our opportunity to unify our approach in trying to understand them.

Teaching the interaction of matter with electromagnetic fields as a unified discipline, at least as a 1-year course, seems to me to offer the following advantages.

1) It would give college students a well-rounded approach to current scientific and engineering problems dealing with materials and devices.

2) It would provide a necessary part of the course structures in materials science and materials engineering.

3) It would provide an excellent background for advanced engineering physics, advanced physics, and mathematical physics courses.

4) It would provide a complementary background for courses in physical chemistry, which now have to introduce as isolated and nearly unrelated subjects such things as x-ray diffraction, electron spin resonance, nuclear magnetic resonance, dielectric loss, and electric polarization, diamagnetism, and electron diffraction.

5) It would provide a complementary background for teaching electrical engineering courses, which now introduce as isolated and little-related subjects such items as gas discharge, solid-state devices, electron emitters, corona, and real magnetic components.

There may be some disadvantages to such a unified approach, but as yet these have not become forcefully apparent to me. I am sure that there are some, and that further thought will undoubtedly disclose them.

The type of course I am talking about is one which would deal not just with the solid state but also with the liquid state, the gaseous state, the phase-boundary states, and the inhomogeneous mixture states (solid particles in liquid, and so on). It would deal with insulators, semiconductors, and conductors; with ferroelectrics, piezoelectrics, and photoelectrics; with dia-, para-, ferro-, ferri-, and antiferroelectrics; and with plasmas. It would be, as I see it, a survey course, designed to do for the physical science courses what advanced calculus courses, as now given, do for mathematics courses.

If what has been said about the need for such a course seems reasonable, then we should proceed to make such a unified presentation. There remains a problem as to just what to call such a course. I submit that an appreciable part of such teaching has been given for some years at various schools under the name of "dielectrics" courses. It therefore seems reasonable, although perhaps not entirely unobjectionable, to suggest that the name "electromagnetics of matter" be used for the broader unified discipline which includes the study of the interaction of matter with electric and magnetic fields. This would release the restrictions upon the study of dielectrics which previously held—restrictions which precluded study of the effects of other than "adiabatic" electrical polarization and dipolar influences. This release of the restrictions would be an advantage, for we now know that electronic processes such as conduction, incipient corona, avalanching, and ionization play major roles in real materials, roles that cannot be incorporated in the older, classical considerations.

The phenomena of polarization, excitation, conduction, and magnetization would be the essence of the newer, unified discipline.

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On Cause and Effect in Biology

In the thoughtful article on cause and effect in biology [*Science* **134**, 1501 (1961)], Ernst Mayr mentions some difficulties presented by the classical concept of final cause. He acknowledges that this concept was introduced by Aristotle in order to explain the goal-directed activities of organisms and to account for the over-all harmony of the world. However, the definition of final cause which Mayr quotes and seems to accept—namely, "the cause responsible for the orderly reaching of a preconceived ultimate goal"—is not easily harmonized with the letter of Aristotle or with his natural realism.

Aristotle frequently refers to the final cause as that for which or for the sake of which something is made or done. He defines the final cause as the goal of action and says that it is recognizable as such when we see that it is regularly