so each fact and inference may in some phase of the progress of knowledge serve to explain the previously unexplained, and thus have importance or comparative value. Apart from such temporary and humanistic relations, all facts are equally important or equally unimportant. When, therefore, an author makes the bald statement that a fact is 'important,' he ascribes to it a quality and not a property; and he is self-deceived if he thinks of the importance as an essential characteristic.

It conduces to clear thinking as well as clear writing if one fortifies the use of 'interesting' or 'important' by pointing out the relation which endows the indicated fact with interest or importance. When that has been done the need for the adjective often disappears; and if it can not be done, the adjective is a meaningless platitude.

G. K. GILBERT.

WASHINGTON, D. C.

SPECIALIZATION, IGNORANCE, AND SOME PROPOSED PALLIATIVES.

I BEG leave to use the columns of SCIENCE to express a few ideas which may strike some readers as strangely naïve, but which have been incubating in my brain for a term of years, and must now at length find some mode of deliverance. I speak as one of that large class of unfortunates who aspire to contribute a few small stones to the temple of knowledge, but who are forced to give so much time to purely routine work that little is left for better things. And that precious little remnant of our time—how do we employ it? Largely in misspent energy and unproductive efforts; not in the quest of knowledge, but of the means of acquiring knowledge; not in learning facts, but in learning how to learn! After we have deducted the time spent in purely mechanical operations, in developing our technique and in digesting the ever-growing literature of our particular little fraction of a sub-science, how much remains of those brief moments spared from the struggle for bread? Is it a wonder that 'general culture' suffers, when even our sister sciences are neglected, or that specialization so often results in an intellectual isolation, fatal alike to the scientist and the man? *Platitudes?*—of course they are! Who has not deplored these conditions? But we all resign ourselves to them as inevitable, just as we do to a social order which tolerates boss rule, 'Standard Oil' and the inheritance of poverty or riches. Who has not wished to halt the march of discovery long enough to allow himself to 'catch up'? And, seriously, would it be a misfortune if we should be compelled to pause for a moment in the exploitation of new facts, and properly assimilate the ones we have? But this is not the burden of my modest message.

One can not but marvel at the absence of any adequate bureau of exchange among specialists in different fields of knowledge. We have our societies, it is true, where papers are presented which are oftentimes too technical even for the limited circle of members—all fellow specialists in a single science. We have our journals, congested with contributions, good, bad and indifferent. But which one of us can follow all the technical journals of his own specialty, even though his path be blazed by international bibliographic catalogues? We have our reviews and year-books and Jahresberichten, in which the topics treated are apt to gain in technicality in proportion to the degree of abridgment. Various semi-popular periodicals doubtless do a splendid work in making accessible some of the more general conclusions of science, but their contents are necessarily fragmentary and uncoordinated.

In our higher educational institutions we find specialists engaged in two chief pursuits: giving instruction to students, and conducting research. A third possible function of the faculty seems never to be fully recognized, namely, mutual enlightenment. Why is there often such utter isolation between various departments? Why has there not been established any recognized clearing-house for the exchange of expert knowledge? Much of such exchange doubtless occurs in a desultory and haphazard way, through ordinary social intercourse, so that a man of requisite personal and social gifts may receive and impart much of value. And doubtless various public lecture

courses do something toward meeting this need. But why not organize in every university an inter-departmental congress, in which members of the various departments shall present, in as palatable form as possible, the problems and discoveries of present interest in their respective branches of learning? On the face of things it would seem that such an arrangement would necessarily result in an added stimulus and a broader horizon for each member of the staff, and a greater solidarity for the whole.

An objector will doubtless be prompt to point out that the above plan, though plausible on paper, would, for one reason or another, be quite impossible in practise. I can only reply that no suggestion which offers the least hope of lessening the baneful effects of over-specialization ought lightly to be dismissed. Nor should I be surprised by the quite different criticism that my idea utterly lacks novelty, that it has long since been threshed over by educational experts, perchance received a fair trial somewhere. In reply, I could but cite my own ignorance of these facts as a fine illustration of the very conditions which I have deplored.

But there is another idea which I cherish just as tenderly—one equally chimerical, mayhap. It is nothing more nor less than the establishment of a sort of human encyclopædia as an adjunct to our libraries. How much of our ignorance is due to the inaccessibility of knowledge! How many questions we allow to pass unanswered, rather than grope blindly amongst unfamiliar volumes! The thought lies near to hand that some one could save us that trouble—some one who would not have to grope. But who? The plain man sends a query to his daily paper, and receives an answer which we hope is more trustworthy than the editorial opinions or news items on the same sheet. Or he may have the temerity to write to an expert, who may be good-natured enough to reply. But where in our educational system is the man or body of men whose recognized function it is to answer questions? Teachers we have by the thousand, employed to impart knowledge in accordance with certain more or less stereotyped courses of study, but where are the men whose business it is to tell us just those things for which we happen to be seeking? The scientific departments of our government, it is true, give much expert advice on various matters, in reply to correspondents, and here, indeed, we find our most instructive models. But their scope is obviously limited.

Suppose that one of our great libraries were to employ a staff of consulting experts, men of the rank of college professors, whose duty it should be to furnish definite bits of information in response to legitimate questions, or at least to guide the seeker on his way. The cost of maintaining such a library would doubtless be vastly increased, perhaps doubled —I leave that for the professional librarian to compute. But over against this added cost could be set the untold hours saved to the student or the layman, searching in unfamiliar fields, and the vastly greater facility of the diffusion of knowledge. My suggestion might easily be caricatured into the proposal that the learner should henceforth dispense with books. Quite otherwise, it is my main object to enable him to do more reading and less groping; to peruse pages of text, instead of card catalogues and tables of contents; to economize time, and to minimize the loss of energy through friction.

In the case of a university library, could not such relations be maintained with the faculty as to permit of members of the latter body being called in for expert advice, not sporadically, but as a part of the organic system? This would throw an additional burden upon the teaching staff, which would, of course, need to be increased numerically. But would not such a function compare favorably in usefulness with the teaching of various prescribed subjects to apathetic learners? To the overburdened specialist, such a system would serve the same end as the plan first proposed, giving him more ready access to other fields of thought, and minimizing the evils resulting from the increasing differentiation of knowledge.

But here again I fear that the experts may smile at my modest suggestion, either as being utterly impracticable, or as quite devoid

of novelty or originality. If so, I can but humbly acknowledge my ignorance, adding once more that this unhappy condition merely strengthens my case!

FRANCIS B. SUMNER.

ULTRA-VIOLET LIGHT IN PHOTO-MICROGRAPHY.

TO THE EDITOR OF SCIENCE: Apropos of Dr. Cleveland Abbe's letter in a recent issue of SCIENCE, I would call the attention of your readers to the fact that the developments in the use of utra-violet light in photo-micrography with apparatus designed at Jena is described in some detail in *Engineering* (London), for December 2, 1904, page 760.

CLIFFORD RICHARDSON.

HOW DOES ANOPHELES BITE?

IN a recent number of SCIENCE Professor Washburn, in the course of some remarks on the mosquito exhibit at St. Louis, prepared by me for the New Jersey State Museum, questions the accuracy of a figure of *Anopheles* in the act of biting. I do not understand him to say positively that the figure is inaccurate, only that it had been his belief that the biting position resembled the resting position more nearly. The figure in question, which was a large colored one calculated to attract the attention of the passers-by, was intended to duplicate the picture given by Nuttall and Shipley in their work on *Anopheles,* its structure and habits. It is really a very accurate copy of their plate and the position in my chart is just exactly as published. This is an explanation, not a justification; if the figure is wrong it should not have been put on exhibition in that way; but is it wrong?

When I read Professor Washburn's note I tried to recall my own experience with *Anopheles.* I recall distinctly, watching specimens bite on several occasions, and particularly at Cape May, where *Anopheles crucians* was very plentiful in 1903 and bit freely during the early morning hours. This habit is unusual in the genus and attracted my attention, so that I gave the insects every opportunity to bite; yet, while I can recall distinctly all the surrounding circumstances, I do not recall just what position the insect assumed when biting. I questioned in turn every member of the field and office force, and found that they were equally uncertain in the matter. All of them had been bitten and all of them were able to recall specific occasions where they watched the insect bite, yet none of them would say positively just what the biting position of the insect really was.

During the summer of 1902 Dr. Herbert P. Johnson studied *Anopheles* for me near Newark, N. J., and kept a number of the insects in confinement, allowing them to bite from time to time, and of course watching the operation. I wrote him to the St. Louis University, where he is at present engaged, and received an answer as follows: "While I have not so distinct a mental picture of the operation as I would like to possess I am very confident he [Professor Washburn] is wrong. The biting attitude he mentions would be a most extraordinary one, and for this reason: it is obvious that the mosquito pumping apparatus must penetrate the epidermis before any blood can be drawn and the epidermis is made up of many layers of cells. To thrust its lancets in obliquely is evidently to encounter more resistance, do more work, and with less prospect of success than to thrust vertically through the many layers of cells of the epidermis. If there is an easy way of doing a thing, nature does not ignore it for a more difficult way. The only way in which *Anopheles* could introduce its bill vertically and still keep it in line with its body, would be for the body to assume the vertical position, which I have never seen it do. It is always somewhat oblique."

Mr. Henry L. Viereck, who spent the entire summer at Cape May for me and who especially studied *A. crucians,* writes: "In biting *Anopheles crucians* stand like *A. punctipennis* as shown in Berkeley's figure 17; that is, with the body and beak nearly in a straight line and at an angle somewhat greater than 60° to the surface. The disposition of the legs during the act I can not recall exactly, but I feel quite sure they were very much as in the figure I have referred to."

These communications were hardly satisfactory and we looked up every reference that was available, only to find that no one who