

We are not really getting down to the big problems. We have to view with concern the slowness with which our attack upon the carbohydrates matures. Little more is settled of the nature of starch than was established by O'Sullivan and Horace Brown in my early days. We have not yet decided even the con-texture of the glucoses. Beilstein, the record of organic chemistry, already has 12 large ordinary and 3 supplementary volumes and will not be completed in less than ten more. It already costs £60. Only real men can teach a subject of such magnitude.

To serve the ends of the British Empire, we have to strain every nerve to secure more competent chemists of all kinds—no delay is permissible. At the moment, industry here and, particularly, in America is thwarting academic efforts to produce them, by tempting men of potential ability prematurely into industry, before their intelligence is sufficiently ripened: by confining their labours, it is tending to promote intellectual sterility; parents so trained cannot have healthy offspring.

University College, in virtue of its Medical School, is marked out as the great biological centre of the future. That future will be indefinitely postponed, unless the College maintain a highly developed, complete Department of Organic Chemistry—pure and applied. To think that a few calculating machines will suffice us in producing a great work of art is obviously absurd.

Prof. Forbes was helped by a single father. I can claim the support of several—of an entire organic ancestry. Hofmann put me to work under Frankland and Frankland sent me on to Kolbe: three lineal descendants of Liebig. Returning, I was adopted by Williamson of University College and became the first Perkin's colleague. Being of such organic parentage, I may claim to speak with some authority. I would urge that it is impossible to think of the service Williamson rendered to organic chemistry, by resolving the chaos surrounding alcohol and ether: then, in the College where he taught, to do the great wrong to organic science that is now threatened. It cannot be! It must not be!

HENRY E. ARMSTRONG.

The Scientific Principle of Uncertainty.

"IF the actual history of science had been different, and if the scientific doctrines most familiar to us had been those which must be expressed in this [statistical] way, it is possible that we might have considered the existence of a certain kind of contingency as self-evident truth, and treated the doctrine of philosophical necessity as a mere sophism."

This is not a quotation from an exposition of the quantum doctrine of the essential uncertainty of physical knowledge, which recently startled the philosophical world. It is taken from the inaugural lecture at Cambridge in 1872 by Clerk Maxwell, the creator, in conjunction with Boltzmann, of the science of dynamical statistics, the development of which gave promise of rapid progress about that time.

The essence of the matter is that in this subject, as it gradually emerged in close connexion with gas-theory, the primary feature was the invariant specification of the differential receptacles or cells for the statistics, propounded as an analytical result by Liouville in his *Journal*, vol. 3, pp. 342-9 (1838), and rediscovered to some purpose by the redoubtable pair, Maxwell and Boltzmann, about 1876. They were stimulated to the broadening of the subject by introduction of generalised co-ordinates in the modern manner, by the physical vitalising of the Hamiltonian revolution in

dynamics of date 1834, by Thomson and Tait in their "Natural Philosophy" in 1868. This re-statement in generalised form appears to have been first exhibited in H. W. Watson's tract on gas-theory in 1876, written with access to Maxwell's private notes published in his memoir of 1879, and its lucidity was remarked on by Boltzmann. The essential point was that in the specification of these invariant cells, a range of any co-ordinate δq occurred multiplied by a range of the cognate momentum δp , and that the factors of this product could not be separated, so that any refinement of exactness in one variable involved a loosening in the other.

JOSEPH LARMOR.

Cambridge, Feb. 14.

Unemployment and Hope.

IT is certainly a hopeful sign to find in NATURE of Feb. 15, p. 225, the interesting article under this heading by Mr. W. G. Linn Cass, ending with the plea that originality and freshness of view in this old question were never in the history of the world more or more urgently needed than now. I trust it may not fall on deaf ears, for in my experience, hitherto, scientific men have shown themselves in this question perhaps rather more bigoted and intolerant than can be wholly accounted for by their natural conservatism. Possibly it is a suppressed consciousness of guilt, for, after all, unemployment or leisure, two ways of stating essentially the same condition, is the most natural as it is the inevitable consequence of their achievements.

In any conceivable economic system, labour-saving is the unquestioned goal of the application of science to industry, but few dare to see the process through to its absurd end under the present system. As science multiplies by n the productability of labour, $(n-1)/n$ lose their livelihood and with it their title to consume, so that, but for the 'dole' and similar confiscatory legislation, consumption would be reduced to $1/n$. No more stupid or criminal waste of creative effort surely could be imagined.

It may be comforting, but it is certainly very short-sighted to argue that it will all come right of itself in the end, because scientific invention and discovery create more work than they displace. Admittedly, at first the $(n-1)$ surplus goes to feed the $(n-1)$ displaced men who are put to create new productive enterprises. When these, in turn, produce, the original deadlock returns in exaggerated form. In this respect New Testament economics was clearer than that taught in modern universities, since it distinguished the category of the wealth which perishes from its negative form, debt, which accumulates at interest. Unemployment, or leisure, should be the avowed object, as it is the inevitable consequence of scientific production.

I cannot subscribe so heartily to the Biblical economics, which I suspect has influenced Mr. Cass to invert the natural function of industry, and to put production as second to the exercise of faculty and the growth of character. The right use of leisure is—Who can doubt it?—one of the dominant problems of a scientific civilisation. But why should industry be necessarily charged with this alien function? It is educational, and should be the care of universities, training schools, theatres, the churches, the Press, and so on. The end is surely easier of attainment by leisured people, supported by what science is capable of supplying without taking their entire lives for it, than as a means of livelihood in competition with scientific methods. Much as on-lookers may deplore the mechanicalisation of industry,