An equal spirit of organised research and munificent endowment in this country should enable us to raise here, on the basis of existing English pioneer work, a similar monument of research on the physiology and energetics of carbon assimilation. F. F. B.

THE ADOPTION OF THE METRIC SYSTEM.

AN account of the position of the subject of the adoption of the metric system in this country was given in NATURE of August 30 last. That the question is being very seriously considered by the controllers of our larger industries is clearly indicated by the two papers on the subject read recently before the Institution of Electrical Engineers. In the paper, "A Case for the Adoption of the Metric System (and Decimal Coinage) by Great Britain," by Mr. A. J. Stubbs, the multiplicity of standards—and, worse still, variations from these standards—is so clearly shown that one is not surprised that the writer should arrive at the conclusion that the change must come, and that delay but increases the difficulties of the change. The final conclusion, "*Do it now*," will meet with unqualified approval from those who feel that the change is urgently needed.

Very different is the paper from Mr. Llewelyn B. Atkinson on "The 'Pros and Cons' of the Metric System." Broadly speaking, it is a paper "damning with faint praise." Starting from the three possible systems, namely, (1) the British system, (2) the metric system, (3) the C.G.S. or absolute system, the writer proceeds to discuss the questions of (*a*) decimalisation, (*b*) the actual magnitudes involved, and (*c*) policy. The main point made is that there is always so much to be said for the other side that everything is questionable. The further difficulty of the enormous number of readjustments of tolls, rates, dock dues, wage lists, etc., which would have to be made, is emphasised.

If our object were simply to criticise this paper rather than most seriously to urge the adoption of the metric system in the full light of all the difficulties actually known to be involved, we should simply ask Mr. Atkinson to produce his British system—say, for the textile industries; and in reply to the difficulty raised respecting the readjustment of tolls, rates, etc., we would suggest that the sooner the whole of the agricultural and commercial worlds of this country receive the shaking up that such a change would give them the better. But the paper is too good to be thus summarily dismissed.

The question of decimalisation admittedly resolves itself into a careful weighing up of the pros and cons. That uniformity, accuracy, and speed make a strong trio in favour of the decimal system is, however, beyond question. If proof of this be required it may be readily obtained from those who have worked in both British and Continental mills and works.

The question of the actual magnitudes involved is complicated by reference to the varying weights of the bushel of wheat, of barley, of oats, etc. This is typical of the whole trend of the paper. Whatever standards of measurement be adopted, the same difficulty will be in evidence. This approximates any two systems to one another in the sense that it involves them in a common difficulty—but does it therefore leave them equally useful for world service? If there were a chance of either Japan or China adopting any such British system as could be speedily designed, there might be something in the argument. But is there?

The question of policy is debated rather from the point of view of Britain holding certain markets by the imposition and retention of her peculiar weights and measures—in other words, by the methods employed by some of our machinists, who purposely adopt their own peculiar standards in order that they may absolutely bind to themselves any firms once depending upon them for machinery. Does not this savour far too much of subterfuge? And where subterfuge comes in, in the long run efficiency goes out.

From this point of view international coinage and rates of exchange form an interesting study. If the time ever comes when the spirit of scientific finance, rather than the spirit of "opportunism," dominates industry, then will commerce have made possibly the greatest step forward on record.

In the final paragraph of his paper Mr. Atkinson asks for some indication of how the change can in practice be effected in the case of the textile industries. This change was definitely made and the metric system employed in the textile industries department of the Bradford Technical College for more than a year. The experiment revealed the simplicity of the change, and has materially influenced the views of the writer of this article on the possibilities of the metric system in the textile industries. That the cotton section of the textile industries will profit least from the proposed change is certain, since it already possesses many of the advantages conferred by a world-wide system; but surely it will join hands with its less fortunate associates in advocating a change which to those with long vision seems almost likely to be the factor deciding our fate in the commercial warfare looming ahead.

But perhaps the deficiencies of outlook in evidence in Mr. Atkinson's paper may best be attributed to an apparent lack of appreciation of the questions of mentality (or psychology) involved. Every mathematical problem solved—be it simple or complex—serves in two ways. Directly, it gives the particular answer required; and indirectly, it incorporates itself into the intuitive faculty of the thinker. Thus each problem solved will naturally tend either to strengthen or to weaken the intuitive mathematical faculty. A multiplicity of standards with many haphazard variations will inevitably tend, through confusion of precept, to suppress, and ultimately entirely to eliminate, the intuitive mathematical faculty; whereas scientific standardisation will tend to promote that type of brain culture which ultimately resolves itself into

cumulative efficiency. That our people markedly lack this intuitive mathematical faculty is too painfully in evidence. A great opportunity is opening out before us to correct this defect. Are we going to make the attempt? Risk there will, of course, always be, but in this case the risk of standing still seems to be far greater than the risk incident upon the compulsory adoption of the metric system.

A. F. B.

CONTROL OF SEX IN PIGEONS.[1]

THE late Prof. Whitman, of Chicago, was the first to show the remarkable suitability of wild pigeons for the analysis of the sex-problem. He found, for instance, that generic crosses (Columba and Turtur), when not permitted to lay many eggs, produce mostly or only males; that such pairs, when made to lay many eggs (crowded reproduction), produce males predominantly from their earlier stronger eggs, and predominantly or only females from the later eggs laid under stress of overwork; and that from eggs of pure wild species the first egg of the pair or clutch more often hatches a male, while the second egg of the pair more often produces a female. Dr. Oscar Riddle has followed up Prof. Whitman's work with very important results, bearing not only on the theory of sex, but also on possible practical control.

It seems certain that there are two kinds of eggs in the pigeon's ovary. The male-producing egg of the spring stores less material than the female-producing egg of the autumn. The male-producing egg of the clutch stores less material than does its female-producing fellow. The eggs of old females store more material and yield a higher percentage of females than do the eggs of birds not old. During the season successive clutches present higher and higher storage, and the eggs of the low-storage period give rise (in the generic cross) to males, and those of the high-storage period produce females.

Increase in storage capacity means decrease in oxidising capacity—a lowered metabolism; and the fundamental difference between the female-producing ovum and the male-producing ovum is a difference in the level of metabolism. Though there are a few discrepant results, it may be said that femaleness in the egg is associated with low metabolism, lower percentage of water, and a higher total of fat and phosphorus, or of phosphatides; and conversely for maleness. The less hydrated state of the colloids will favour increased storage, while a more hydrated state will favour a higher rate of oxidising metabolism. Analysis of the blood and constitutional features of adult birds gives some indication that the metabolic differences of male and female germs persist in the male and female adults. A calorimetric determination of the energy-value of hundreds of eggs confirmed the reality of what may be called metabolic dimorphism, agreeing with the conclusions reached from studies on the weights of yolks and on yolk analysis, and strikingly consistent with the breeding data. "We could say, if we wished to make merry with our colleagues, the cytologists, that we here get closest to the facts of sex when we *burn* our chromosomes."

Some of the incidental corroborations of Dr. Riddle's thesis are very interesting. Thus females hatched from eggs laid early in the season tend to be more masculine in their sex-behaviour than their own full sisters hatched later in the season. "Several grades of females can be thus seriated according to the season of hatching." Again, the female hatched from the first egg of a clutch is, in a great majority of cases, more masculine than her sister hatched from the second of the clutch. Another sidelight may be found in the frequency of a persistence of the right ovary in birds hatched from eggs which are otherwise known to be most feminine.

Numerous facts converge to the conclusion that "sex and characteristics other than sex, such as fertility and developmental energy, not only bear initial relations to the order of the egg in the clutch, but that sex and these other characteristics are progressively modified under stress of reproductive overwork, until at the extreme end of the season certain aspects of femininity are abnormally or unusually accentuated. In the light of these facts sex reveals itself as a quantitative modifiable character," associated with modifiable metabolic levels.

Dr. Riddle's view of sex, based on experimental results, is akin to the biological interpretation expounded by Geddes and Thomson in "The Evolution of Sex" (1889), that the fundamental difference between maleness and femaleness is a difference in the ratio of katabolic to anabolic processes, and that the determination of sex is to be looked for in factors affecting the rate and the nature of metabolic processes in the germ-cells or in the early stages of development. Dr. Riddle partially recognises the anticipation: "A general classification of male and female adult animals on the basis of a higher metabolism for the one and a lower for the other was indeed made by Geddes and Thomson many years ago. It now seems beyond question that this conclusion of these authors is a correct and important one."

Dr. Riddle's physiological view of sex is in harmony with many experimental results reached by other investigators, as may be illustrated by reference to Baltzer's beautiful experiments on the worm Bonellia, where there is striking dimorphism between the large female and the pigmy male. The newly hatched larvæ are capable of becoming either. If they happen to become attached to the proboscis of an adult female they become males; if they settle into the sand and mud they undergo, quite slowly, further development into females (almost exclusively). If the free-swimming, indifferent larvæ are artificially helped to a connection with the proboscis of an adult female, and then removed at progressively longer periods, the significant result is the production of practically all stages of hermaphroditism. Those

[1] "The Control of the Sex Ratio." By O. Riddle. Journ. Washington Acad. Sci., vii. (1917), pp. 319–56.