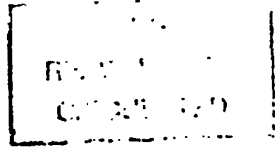


Confidential and probably not

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RANKING CIGARETTE BRANDS ON SMOKE DELIVERIES

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In 1953 tests of selected filter tipped brands were introduced by the American Medical Association. In 1957 "Readers' Digest" in the U.S.A. began publishing listings of brands showing the deliveries of "tar" and nicotine. By 1977 some ten countries had introduced such brand rankings, although there were many variations in the procedures for measuring deliveries. There were and still are, for example, variations in the conditions under which cigarettes are smoked, the smoking machine used, the method of smoke collection and the analytical procedures followed. Most brand tables list the deliveries of tar and nicotine, although figures for additional compounds in smoke have been issued in certain countries.

In some respects it is unfortunate that cigarettes have been tested for so long by simulated smoking. There is no prima facie reason why such a method should be chosen. It might easily have developed differently. Cigarettes might have been crushed and the tobacco pyrolysed under some standard conditions. Several attempts were made to develop such techniques because the use of simulated human smoking entailed, for research work, the great burden of producing cigarettes. Because of the need to select such cigarettes to some constant properties (such as moisture content) they must be produced in considerable numbers. It would have been of great help in research if a standard laboratory technique could have been widely adopted which could be used on small samples of tobacco and paper without the need to go through to cigarettes. But apart from this it is doubly unfortunate that machine smoking under fairly arbitrary conditions, probably different from those of any known human smoker, should be so often and so wrongly regarded as equivalent to human smoking.

Presumably the main objective in publishing the ranking of cigarette brands, as shown in Table I, is to encourage smokers to choose their cigarettes using better information. There is some

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evidence (Hammond et al., 1976; Dean et al., 1977; Bross and Gibson, 1968; Wynder, Mabucke and Beattie, 1970) which can be interpreted to show that the incidence of diseases associated with smoking should be reduced when cigarettes with lower deliveries of some components are smoked. It may be argued, therefore, that it is reasonable to encourage smokers to reduce the general level of tar available for inhalation. If the information in ranking tables helps smokers so to choose it may be considered that, as far as simple tables (such as the D.H.S.S. list in Table I) are concerned, there is some degree of validity.

However, epidemiology, by its nature, can tell us nothing about individuals; it is concerned only with populations. And people do not smoke cigarettes like machines; they do not necessarily smoke successive cigarettes of the same brand in the same way and it is unlikely that different brands are smoked in the same way. Work in B.A.T laboratories (Creighton and Lewis, 1977) shows this. The summary in Table II indicates that individual smokers take in very different amounts of tar from those indicated by machine smoking. We are also aware that the way in which individuals smoke can change the smoke chemistry of the same brand one from another. Nevertheless if an individual smoker retained exactly the same smoking behaviour he would receive less tar from a low tar cigarette than from a cigarette in, say, the middle tar range. Also, it is true that a smoker would find it difficult to get as much tar from low tar cigarettes as from those in the highest categories unless he increased the number of cigarettes he smoked. Certainly if he modified his smoking behaviour only slightly by moving from one brand to another, the finer differences in the D.H.S.S. Table would become meaningless or even misleading. For example, consider a smoker of a LOW TO MIDDLE tar cigarette with a tar yield of 11mg and nicotine of 0.9mg. If this smoker changed to a low tar cigarette with 9mg tar and 0.7mg nicotine and increased his puff volume to receive the same nicotine he would be smoking a cigarette yielding nearer 12mg tar. Throughout the Table it can be shown that any "fine tuning" is readily defeated by quite realistic but small changes in smoking behaviour. A change by only one puff would readily reverse the positions of adjacent cigarettes and for those at the top and bottom of bands would shift

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cigarettes into different bands. A change of one puff coupled with a ten per cent increase in puff volume could transpose the position between the middle of the LOW TO MIDDLE band and the MIDDLE TAR band.

Furthermore, in addition to variations in the way in which cigarettes are smoked, we can infer that there are also differences in the way in which smoke from different cigarettes is inhaled. Guillerm and his colleagues at Toulon (Guillerm et al., 1974) compared the way in which a panel of smokers smoked two cigarettes, "Gallia" and "Gauloises". The results are shown in Table III and suggest, if carboxyhaemoglobin measurements are related to depth of inhalation, that the smoke from the lower delivery cigarette ("Gallia") was inhaled differently from that from "Gauloises".

It is also well known that alkaline mainstream smoke is more difficult to inhale than acidic smoke and a continuous spectrum of smoking products in this respect could be produced from among known brands around the world.

Theoretically brand tables might be developed for a whole variety of known compounds in smoke. Brand ranking tables with measurements such as carbon monoxide or nitrogen oxides have already appeared. For these compounds the relationship with any particular disease is obscure and it is possible, and in some cases proven, that the effects of individual smoke compounds can be modified by synergistic or antagonistic effects of other compounds present in smoke.

If smokers adjust their smoking behaviour on the basis of a response to tar or nicotine the deliveries of compounds such as carbon monoxide, as measured by smoking machine, have even less relevance for individual smokers than do the corresponding figures for tar and nicotine.

Guillerm et al. (1974) have shown that the retention of carbon monoxide by smokers is not determined solely by the carbon monoxide delivery of the cigarette. Somewhat similar findings have been reported by Wald, Idle and Smith (1977). Carboxyhaemoglobin

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levels in smokers who smoke unventilated filter cigarettes were, on average, higher than in smokers of plain cigarettes, as expected on the basis of machine smoking. However, the mean carboxyhaemoglobin level in subjects who smoked ventilated cigarettes was 7% higher than in those who smoked plain cigarettes, although the ventilated filter cigarettes had deliveries 21% lower than the plain cigarettes when smoked by machine. Results for cigarettes containing added nicotine (Dunn and Freiesleben, 1977) also indicate that the intake of carbon monoxide is not simply related to machine smoked measurements of the delivery of carbon monoxide.

If smokers adjust their smoking behaviour on the basis of nicotine intake, there is the implication, as expressed by Russell (1976), and shown in Table IV, that the preferred index would be the ratio of nicotine to tar or the ratio of nicotine to carbon monoxide or maybe both. A "merit index" which in some way added tar, nicotine and carbon monoxide together would, of course, be wholly misleading. Yet this is precisely what some have tried to do. The so-called Herzfeld index attempts to add together total particulate matter, nicotine, carbon monoxide and nitrogen oxides using inconsistent units!!

The assumptions implied in putting forward such an index are quite unacceptable. There are assumptions about relating the toxicity of simple compounds such as nitrogen oxides, nicotine and carbon monoxide with such very complex mixtures as in tar. There are assumptions that various diseases are related simply to specific compounds and complex components, that these do not interact, that they are linearly dose related, and that there are no thresholds. Further, it is assumed that various diseases may be ranked against each other: in what way (social cost, economic cost or loss of expectation of life) is not said. It is difficult to believe that such indices can be seriously proposed. There is, of course, no scientific basis whatever. They could readily be created to position any selected products in any rank order. Yet amazingly a similar approach was published in Belgium which did not include mainstream oxides of nitrogen but threw in sidestream carbon monoxide - presumably for luck!

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It is concluded that while simple brand ranking tables do give information which may be useful to some smokers and by and large may assist a drift towards lower tar cigarettes in general, nevertheless they may mislead individual smokers. In particular small differences in simple tables are meaningless and suggestions that single indices covering several factors have any scientific foundation at present must be totally rejected.

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