Summary

1. Cigarette smoking may be claimed to be a health hazard, but, not the smoking of tobacco.

2. It is claimed by Bell and Laing that control of combustion temperature is the key to safe operation of the cigarette. Oxidation-potential appears to play a relatively minor role.

3. A special cigarette construction provides the necessary combustion control for a wide range of tobaccos.

4. A cigarette is described which is composed of the conventional materials, No additives are introduced.

5. Temperatures encountered in operation are roughly 150°C to 200°C below those normal to a conventional cigarette.

6. A wide variety of technical and commercial advantages stem from the new construction.

The recent report issued by the U.S. Surgeon-General's Advisory Committee on Smoking & Health presented major conclusions which were not so much opposed to the smoking of tobacco as to the use of cigarettes. Other evidence exists which suggests that as far as Health is concerned, it is the cigarette function which is defective and not the smoking of tobacco, per se.

The report indicated that the average mortality ratio for cigarette smokers was 1.70 : 1, as compared to ratios of 1.05 : 1 for cigar-smokers and 1.01 for pipe-smokers. From these observations it may be deduced that cigarette-smoking seriously increases the risk of death (70 times that for the pipe-smoker) while the mortality prospects of cigar- and pipe-smokers are barely differentiated from the norm for non-smokers.

After considering evidence from many sources, together with the above-mentioned Report, Messrs. Bell and Laing felt that there was sufficient justification for the view that a gross disparity existed between the danger presented to health by cigarette-smoking on the one hand and by pipe- and cigar-smoking on the other.

Further consideration led them to conclude that the health hazards of cigarette-smoking must be directly associated with products of tobacco combustion which, while present in physiologically significant amounts in cigarette operation, are normally present to a much lower extent (possibly absent) in the operation of pipes and cigars.

During the combustion of hydrocarbons, of the type found in tobacco, two types of reaction occur, namely: pyrolytic and oxidation-reduction. The former includes distillation, dehydrogenation, cracking, molecular rearrangement and condensation, while the latter includes exothermic reaction of hydrocarbons with oxygen.

The products evolved by pyrolytic reaction, in a given tobacco substance, are determined, very largely, by the temperature at which the pyrolysis occurs, and, of course, by the duration of the reaction.

The extent and direction of the oxidation-reduction reactions, during the combustion of a given tobacco substance, depend to a very large extent on the combusion temperature, as well as the degree of oxidation and the rate of gas flow through the combustion zone.

It will be appreciated that surface/volume ratios for the tobacco will have the normal influence upon reaction kinetics.

Applying thermo-dynamic reasoning to the problem of tobacco combustion, Messrs. Bell and Laing were led to the view that the nature of the reaction products evolved during combustion of a given tobacco would be determined, essentially, by the combustion temperature and the oxidation potential.

These views were confirmed by a series of controlled experiments. It was shown that the products of combustion of tobacco in cigarettes, pipes and cigars, were governed largely by temperature of operation and only to a minor degree by oxidation-potential.

The problem of devising a safe cigarette thus resolved itself into one of providing for lower combustion temperatures, both during idling and running, with the practical requirement, of course, that the idling conditions would be sufficient to sustain minimal burning over adequate intervals of time.

The practical outcome of this work was a simple cigarette which has the following characteristics:-

1. It has precisely the same external appearance as that of a normal cigarette.
2. It employs exactly the same materials as is normal to conventional cigarettes. No additives of any kind are employed.
3. On the basis of early experience it would appear that it can employ a wider range of tobacco types than is customary. For example, an exceptionally mild and flavourful smoke has been obtained from standard pipe tobaccos when employed in the recommended construction.
4. The duration of smoking for a given weight of tobacco is greatly extended by something of the order of 100%

   Conversely, a pleasant smoke of normal duration is achieved with less tobacco - roughly 50%.
5. It possesses the desirable combustion characteristics of a pipe or cigar, and consequently, removes the technical basis for stigmatization of the cigarette as a potential health hazard.
6. It can be employed with or without mentholation and/or filters, and in this respect represents a quite flexible concept in application.
7. It provides a triple combination of:

(a) traditional convenience in use

(b) mild, full flavour

and (c) association with an established safe mode of smoking

which represents a strong image which can be truthfully presented to the public.

8. In view of (5) it relieves the burden placed upon filter/charcoal combinations. In fact it appears that the filter may be required solely to provide controlled resistance to gas flow.

The Bell-Laing Cigarette (U.S. Patent applied for)

As will be seen from the accompanying sketch, the subject of the invention closely resembles a conventional cigarette, but with a central bore which does not extend quite the full length and which is substantially free of tobacco. The important difference is that the tobacco (10) is packed so as to offer a resistance to gas flow which is roughly ten times that normally encountered in a conventional U.S. cigarette. Gas flow down the central bore (12) is relatively unrestricted but is controlled by the resistance in (14) which may be provided by appropriately packed tobacco or, more conveniently, by appropriate filter bodies, in such a manner that the overall puff resistance is normal. The various physical parameters are carefully defined in the U.S. patent application, and it is pointed out that while a relatively empty bore (12) is desirable, other conditions may be permitted which are essentially equivalent and are to be considered as being within the scope of the invention.

It is important to note that this cigarette is not to be regarded merely as a device whereby dilution of the smoke with air is achieved. Such cigarette devices are old in the art and do not achieve the same effect or the same control of the combustion process and products.

After the cigarette is lit, a "fireball" is maintained at the tip as with conventional cigarettes and the movement of the shredded tobacco, as it is combusted, tends to produce a closed structure in the fireball and the attached ash beyond, as is normally the case.

In operation, longitudinal gas flow, from the combustion zone back through the mass of unburned tobacco, is minimal and this channel is no longer employed to convey the products of combustion to the mouth. Circulation

of incoming air is seen to be mainly inwards through the combustion zone towards the central bore of low impedance. Combustion occurs in successive layers of tobacco and the hot gaseous products are removed radially inwards, and down the central bore, and not through the tobacco.

The conditions of smoking at the end of a smoke are almost identical to those at the commencement.

The control over rate of combustion is such that low temperatures (roughly 150°C to 200°C below conventional cigarette operation) are maintained, the resulting products of combustion are more pleasant in flavour and, one is forced to conclude from thermodynamic reasoning, considerably less injurious to health. The duration of smoking, per unit weight of tobacco, is roughly doubled and this confirms expectations based on temperature measurements during experimental mechanical smoking.