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The Local Incidence of Cancer in
France in Relation to Fuel.

BY

C. E. GREEN, F.R.S.E.

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The first part of the book is
France in the 17th century

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THE ROYAL INSTITUTE OF FRANCE IN PARADE
IN PARADE IN 1771
By J. B. DE LAUNAY

The first distribution of books in France is very interesting
because it shows the state of the library of the
Institute at that time. It is not only a list of books
but also a list of the names of the authors and the
titles of the works. It is a very valuable document
for the history of the library and the history of the
Institute.

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THE LOCAL INCIDENCE OF CANCER IN FRANCE IN RELATION TO FUEL.

By C. E. GREEN, F.R.S.E.

THE local distribution of cancer in France is very interesting. Statistics alone, however, as given by the Ministry of the Interior, do not tell their story so clearly or so well as a diagrammatic map, and three most instructive maps are given in an article in *La Presse Médicale*, 13th May 1911, by M. Bertillon. These maps show diagrammatically on each department of France small rectangles, the height of each of which is proportionate to the figure above it, which figure shows the deaths from cancer per hundred thousand inhabitants living. The shaded squares are above the average, the white squares are below. These maps are shown in Figs. 1, 2, and 3.

Fig. 1 shows the death-rate per hundred thousand inhabitants in the *country districts* for the years 1906, 1907, and 1908.

Fig. 2 shows the corresponding death-rate for the *towns* of over five thousand inhabitants.

Fig. 3 shows the towns and country districts compared for the year 1908 alone.

A glance at these maps will show that cancer is largely confined to the northern half of France.

As M. Bertillon states, if a line be drawn from La Rochelle to St. Etienne and from there to the Rhône, the square formed by this line—the Rhône, the Pyrenees, and the seas—does not contain a single department where cancer is frequent. Whereas if a square be drawn, having for its boundaries on the west the sea, and on the other side three lines going from Caen to Angers, and another from Angers to Dijon, and the third from Dijon to Mézières, in every department inside this square cancer is prevalent, the death-rate per hundred thousand inhabitants living being four or five times as great as it is in the south.

The object in preparing Figs. 1 and 2 was to show that for three years the death-rates had been fairly constant; in preparing Fig. 3, to show that, as a general rule, cancer was much more prevalent in the towns than in the country, and this can be seen at a glance. The comparative death-rate in town and country districts for the year 1908 is striking, the average per hundred thousand living being in the towns 103 deaths and in the country 62, or nearly half.

M. Bertillon seeks in vain to find an explanation for this curious distribution and for the difference between town and country.

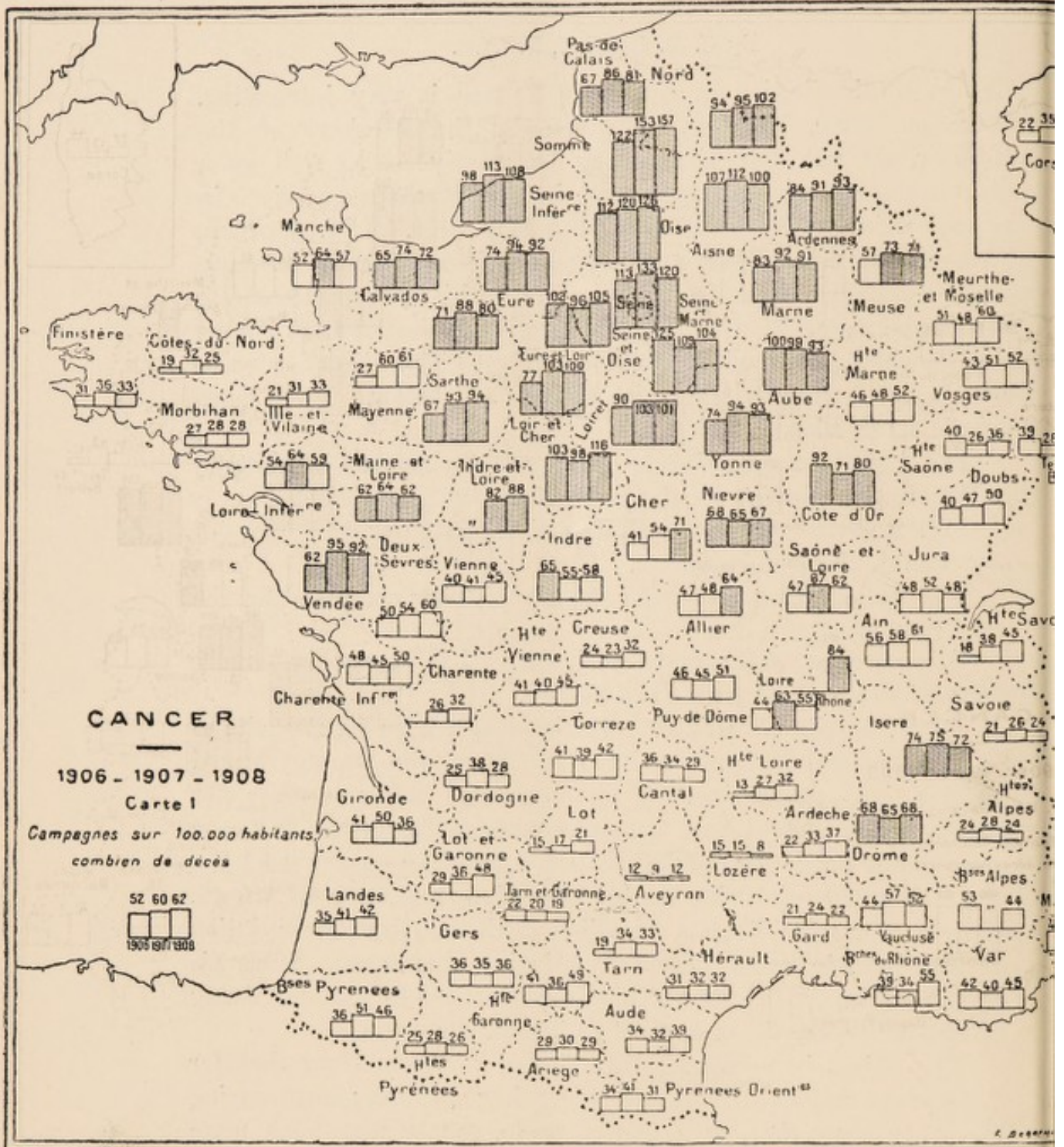


FIG. 1.

At first sight, he says, the distribution seems to follow the geological map of France, the deadly square lying in the basin of which Paris is the centre, but this cannot, he admits, apply to

Pas de Calais, Nord, and Somme, which do not form part of the basin and yet suffer much from cancer.

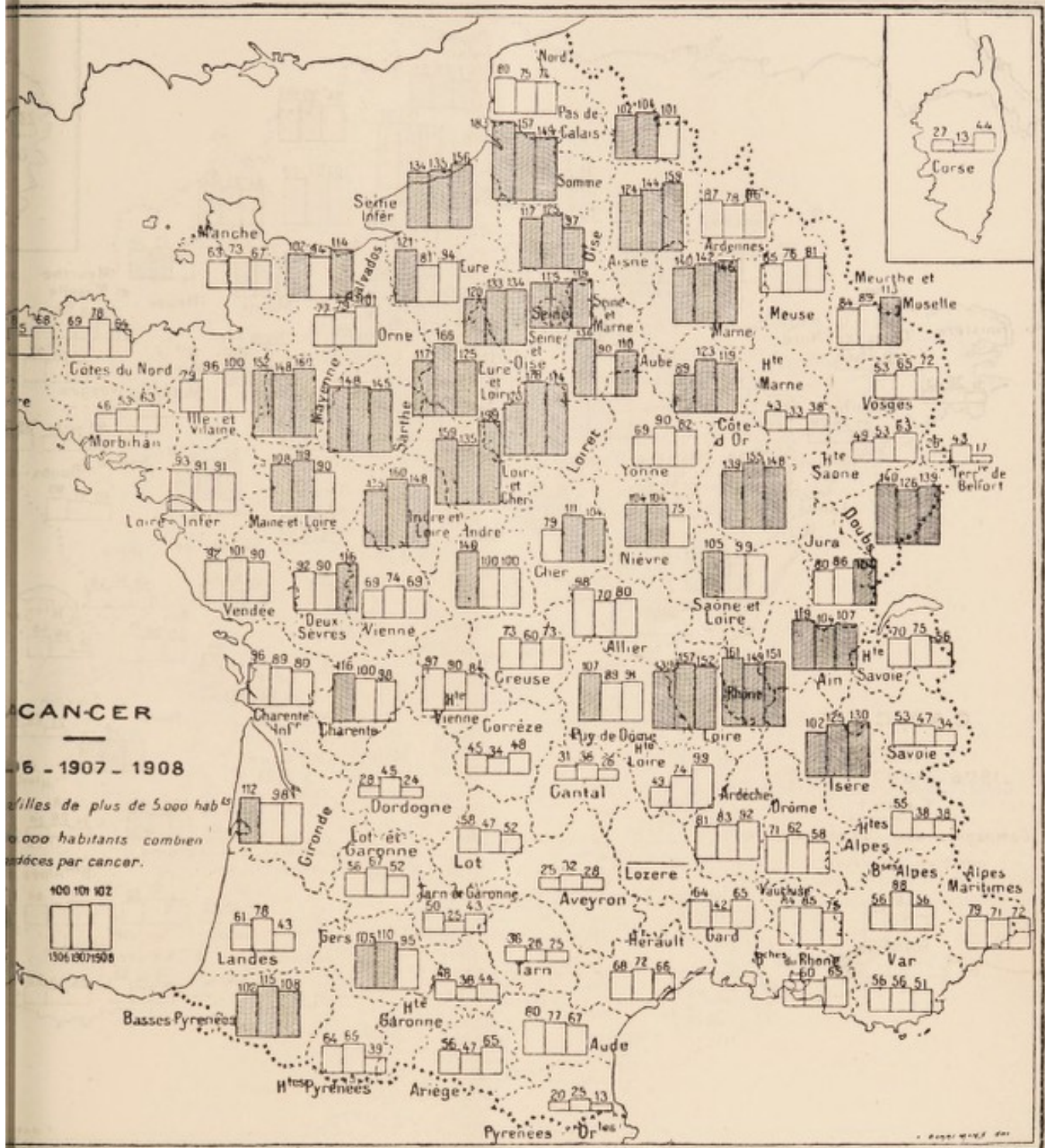


FIG. 2.

The map follows also, to some extent, he further indicates, that of the alcoholic consumption; and yet he points out that Brittany, which suffers little from cancer, has a large alcoholic consumption.

tition dans les villes est analogue, mais pourtant moins nette.

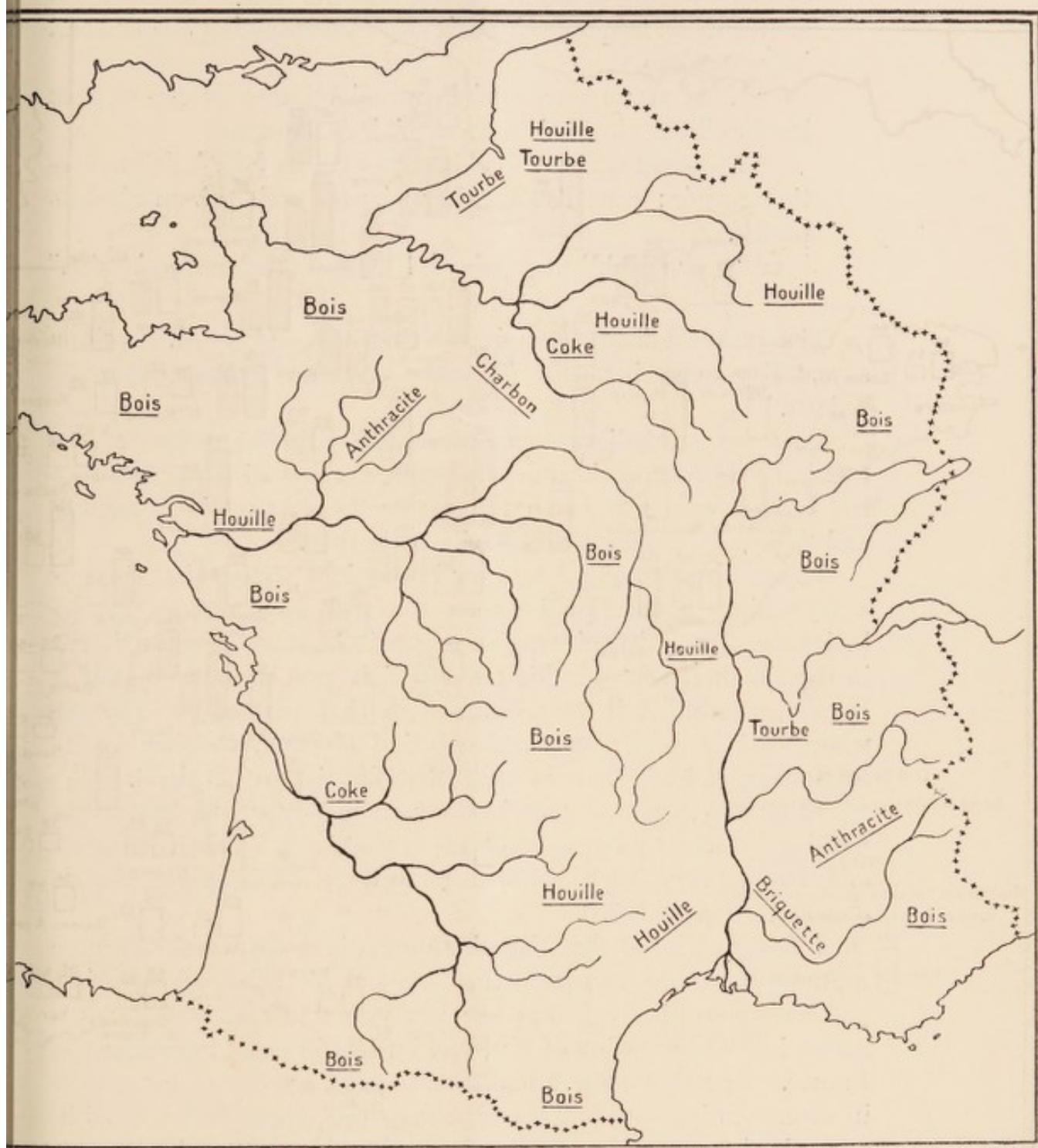


FIG. 4.

“ A cette répartition dans les campagnes, il y a certainement une cause et probablement une cause unique. Cette cause, nous l'avons cherchée sans la trouver.

“Nous avons constaté l'augmentation générale de la fréquence du cancer. Nous avons vu que c'est seulement le cancer du tube digestif (cavité buccale non comprise) qui augmente de fréquence à Paris depuis trente-cinq ans et aussi à Amsterdam.

“Nous avons remarqué la rareté relative du cancer chez les Israélites en Algérie et aussi à Amsterdam.

“Peut-on rattacher quelques-uns de ces faits à l'alimentation carnée; nous l'avons cherché, sans arriver à un résultat positif.

“Que de problèmes soulevés! Que de recherches à faire.”

The problem is truly an interesting one, and, as M. Bertillon says, “Il y a certainement une cause et probablement une cause unique.”

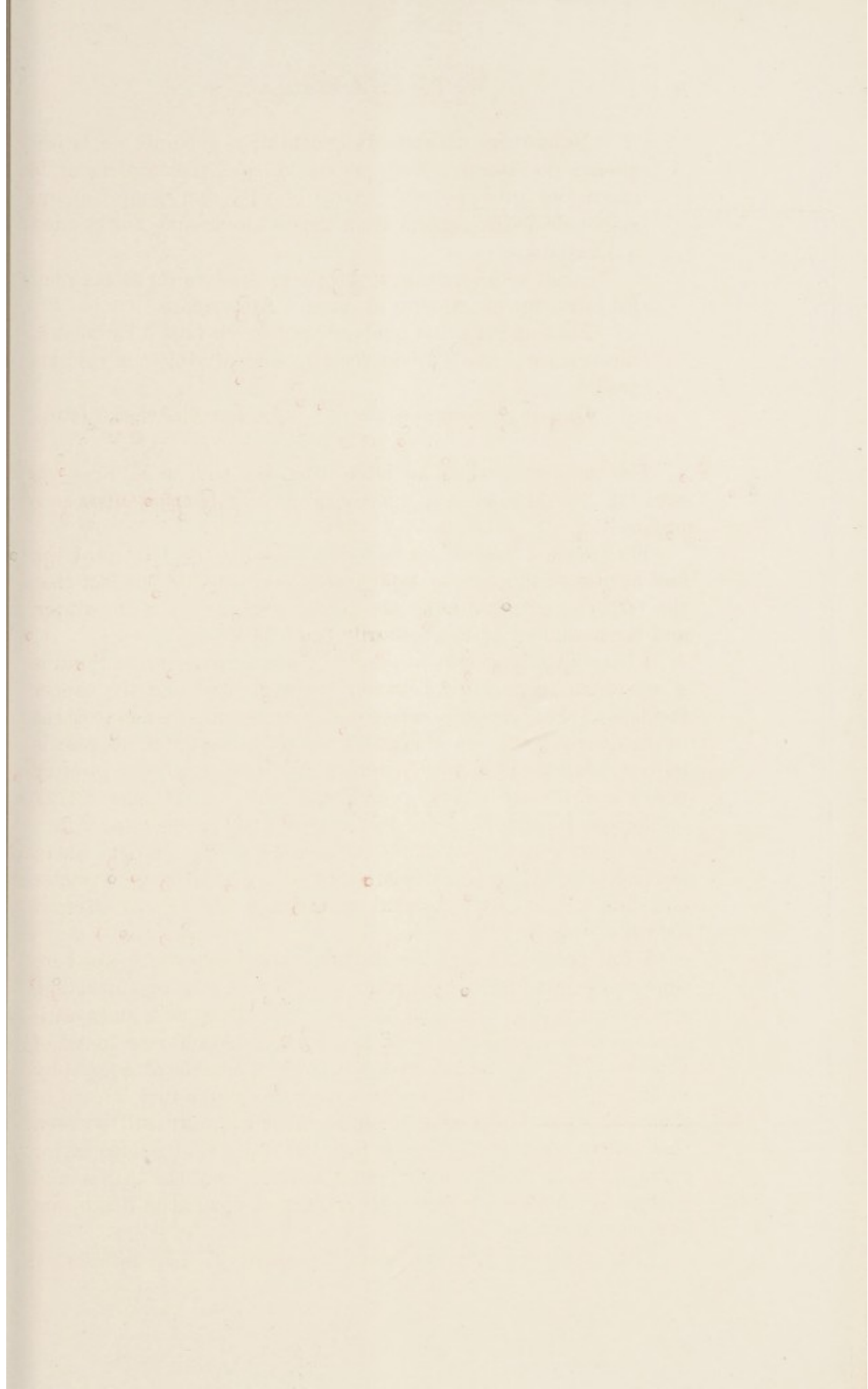
That cause I believe to be connected with the nature of the fuel burned in the various departments, coupled with the fact that the farther one goes north the colder the country is in winter, and the more fuel must necessarily be burned.

I have already sought to show in previous papers that there is a mysterious connection between the fuel used and the cancer incidence. In Nairnshire cancer seems to be actually non-existent in the districts where nothing but a light non-sulphurous peat is burned, whereas it is very common in that part of the country where coal is used (*Edinburgh Medical Journal*, October 1912), commoner, indeed, than in any other district in Scotland.

In Orkney, again, cancer is common in a few districts where nothing but peat is burned when that peat is coal-like in character and has a very high sulphur percentage (*Edinburgh Medical Journal*, August 1913).

I felt convinced that the diagrammatic maps which are here reproduced would throw further light upon this fuel question, and have accordingly during the last year undertaken an investigation into the question of the fuel burned in each department of France. The first step I took was to get a teacher of geography in France to indicate roughly on a map the staple fuel burned in each district, and this map is shown in Fig. 4. It will be seen that where wood is the staple fuel the death-rate is low, as, for example, in Brittany, along the Pyrenees, and the Alpes and Vosges Mountains. Where coal is burned, again, the death-rate is abnormally high.

This diagram, however, did not seem to me sufficiently



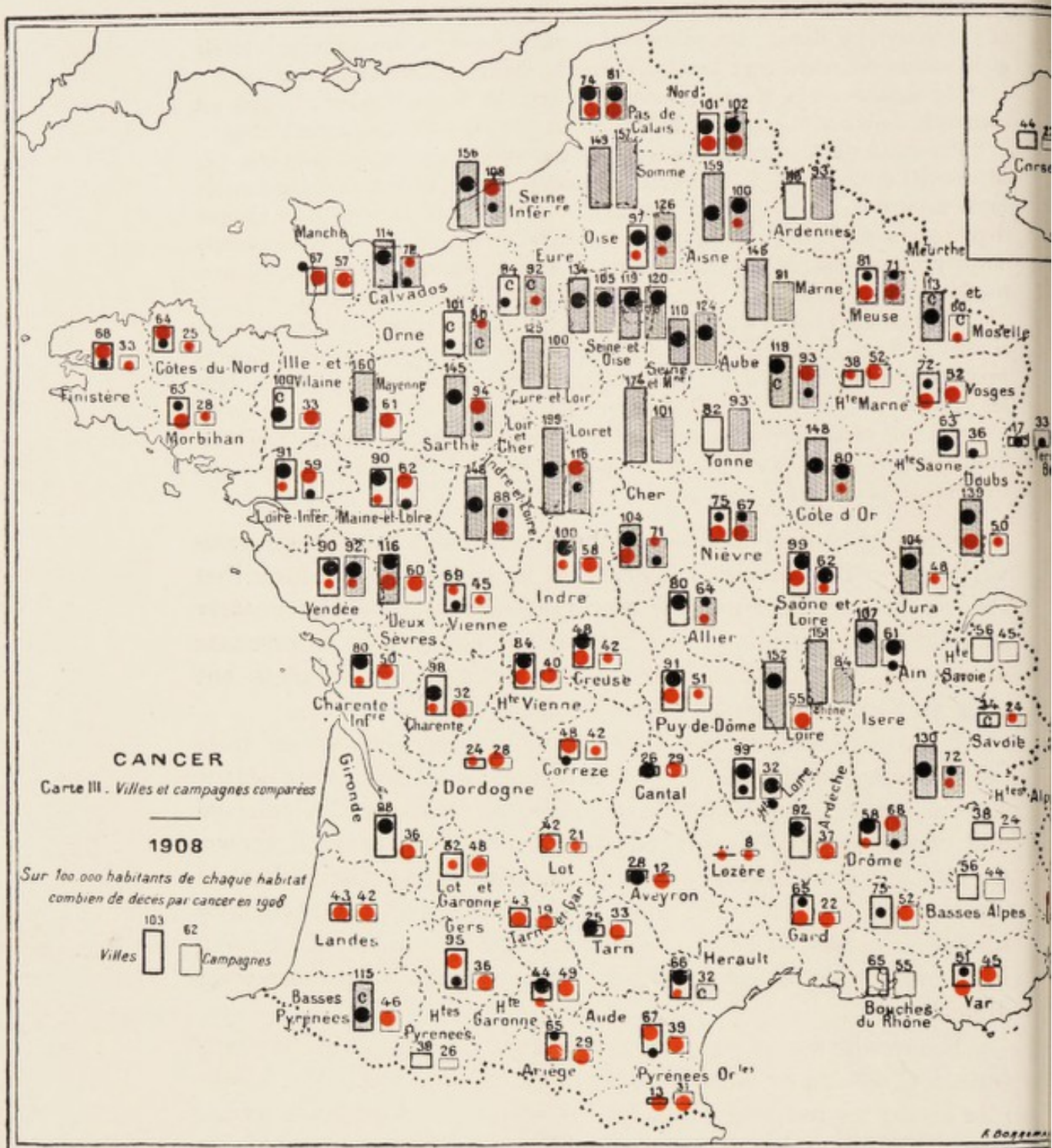


PLATE I.

detailed, and I felt it was worth while writing the Préfet of each of the departments in France the following letter:—

“Depuis plusieurs années j'ai travaillé aux causes qui produisent le cancer, et j'ai trouvé, en Ecosse, une connexion mystérieuse entre son occurrence locale et la nature des matériaux employés pour le chauffage des habitations.

“Je trouve qu'en Ecosse, partout où l'on brûle du charbon, le mal est commun, mais où la tourbe ou le bois est employé il est extrêmement rare.

“Par suite de la très bonne série de statistique récemment préparée par M. Bertillon de Paris, je désirerais beaucoup accomplir une investigation de la même sorte en France. M. Bertillon montre les cas de mort dans chaque département et je tiendrais à avoir des détails concernant les combustibles employés dans chaque département de la France, ensuite, préparer une carte, montrant ces informations comparées à celles de Monsieur Bertillon.

“Auriez-vous l'obligeance de m'écrire une courte lettre me faisant savoir si c'est le charbon ou le charbon de bois, le bois ou la tourbe que l'on emploie principalement dans votre département (1) dans les campagnes, (2) dans les villes.

“Je suis fâché de vous déranger ainsi mais je pense que comme moi vous admettez que tout éclaircissement sur la cause de ce mal terrible a son extrême importance.”

I cannot sufficiently thank these gentlemen for the kindness with which they have met my request, and I venture to think that the results have been more than worth the trouble. Unfortunately some of the departments had not replied before this unfortunate war broke out, and the results are accordingly not complete, but they are quite sufficient I feel to be convincing.

I have worked out on Plate I. the first reports received from each department as follows:—Where only wood is burned this is shown by a red spot, where only coal by a black one. Where coal and wood are both used red and black spots are both shown. C. stands for charcoal, and it is surprising how little charcoal after all is burned in France as compared with coal, which is known as *houille* or *charbon de terre*. The exigencies of printing have made the reproduction of my original map somewhat difficult.

The results seem to me to be striking. In nearly all the towns some coal is burned, and this, to my mind, explains the higher death-rate in the towns, the average for the whole of France being, as has been said, 103 per hundred thousand living in the towns and 62 per hundred thousand living in the country districts. It will be seen that wherever nothing but coal is burned the town death-rate is very high; where wood and a little coal is burned the death-rates of both town and country are average; and where only wood is burned the death-rates are very much below the average.

In Brittany wood alone is burned in the country and only a little coal in the towns. The death-rate of both is much below the average. Further east, however, where only coal is burned, the death-rate is very much above the average.

Two striking instances are Loire and the Basses Pyrenees. In both cases practically only coal is burned in the town districts and only wood in the country, with the result that the town death-rate is in both cases nearly three times that of the country.

To return, however, to Brittany. It will be seen that in the western departments the death-rate in the towns is more than double that of the country, and that the fuel in the country districts is invariably wood, and wood and coal in the towns. Further south, on the seaboard, a considerable amount of coal is burned in town and country alike, whereas to the south-east practically nothing but wood is burned, with the result that the death-rate drops in both town and country with the interesting exceptions of Cantal, Aveyron and Tarn, to which I shall refer later.

Interesting as this comparative map is, I felt that it would be even more interesting were I to check these results and work them out on the two maps, showing the town and country death-rates independently of one another. This involved further correspondence in certain cases and some readjustments. The results are shown on Plates II. and III.

Where coal is practically the only fuel burned I have put a broad black line across the small rectangles. Where wood is practically the only fuel burned I have put a red line. Where both coal and wood are burned I have put a black and a red line; but in cases where I have been informed that coal is the staple fuel and wood is used only to a considerable extent, I have put the black line above the red one, and vice versâ.

To take the first of these maps (Plate I.) it will be seen that in nearly all the town districts of France coal is largely used. Wherever coal is exclusively burned it will also be noticed that the death-rate is invariably very high, as is the case also where charcoal is burned. The fact that charcoal seems to be as dangerous as coal is not surprising when it is borne in mind that in the Kangri basket, which undoubtedly causes malignant tumours in the natives of Kashmir, the fuel used is charcoal, specimens of which I have received lately by the kindness of Dr. Neve.

On the other hand, where wood is burned exclusively, as in Dordogne, Tarn, Lot, Lozère, and the Pyrenees Orientale, it will be seen that the death-rate is very low.

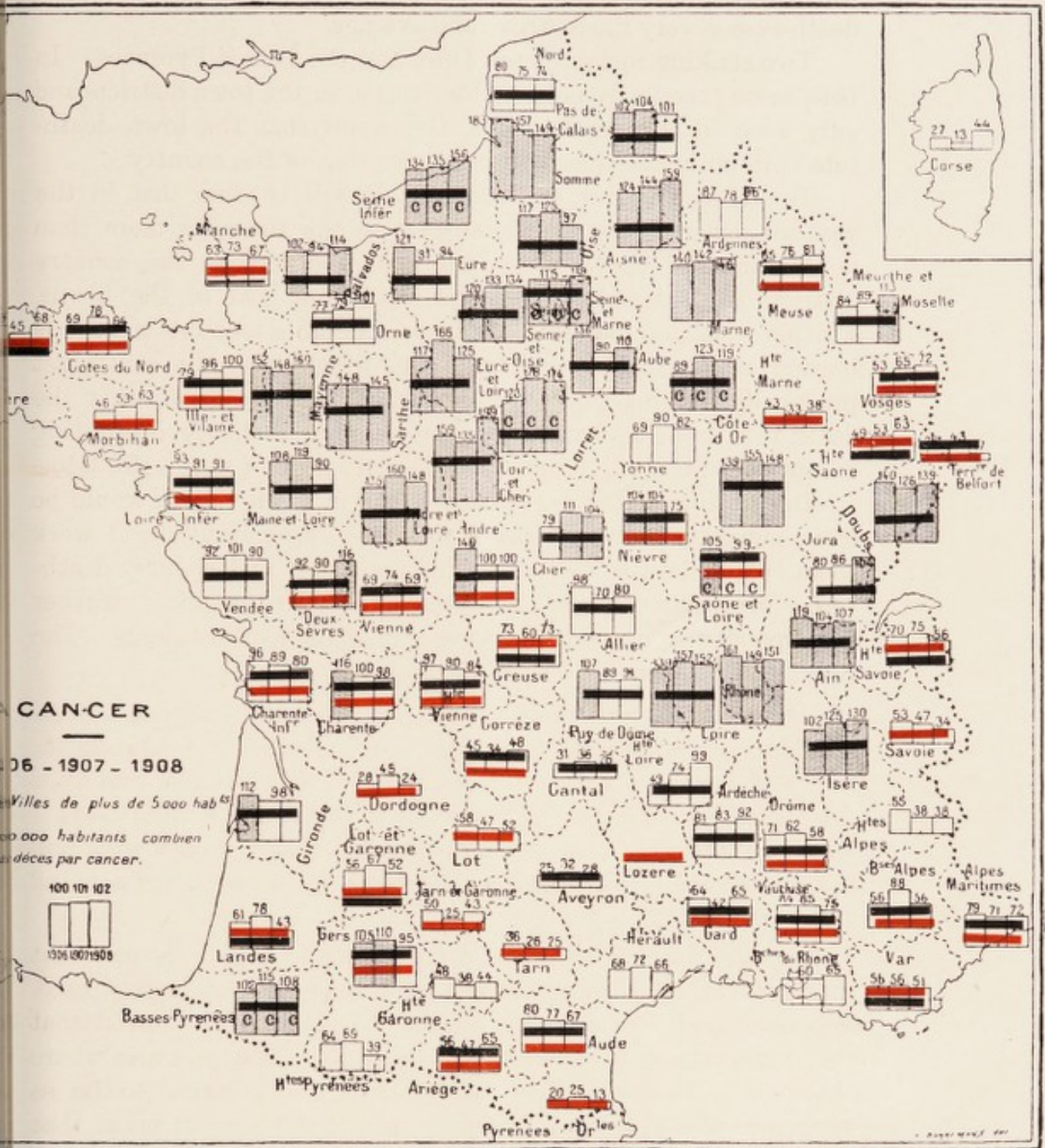
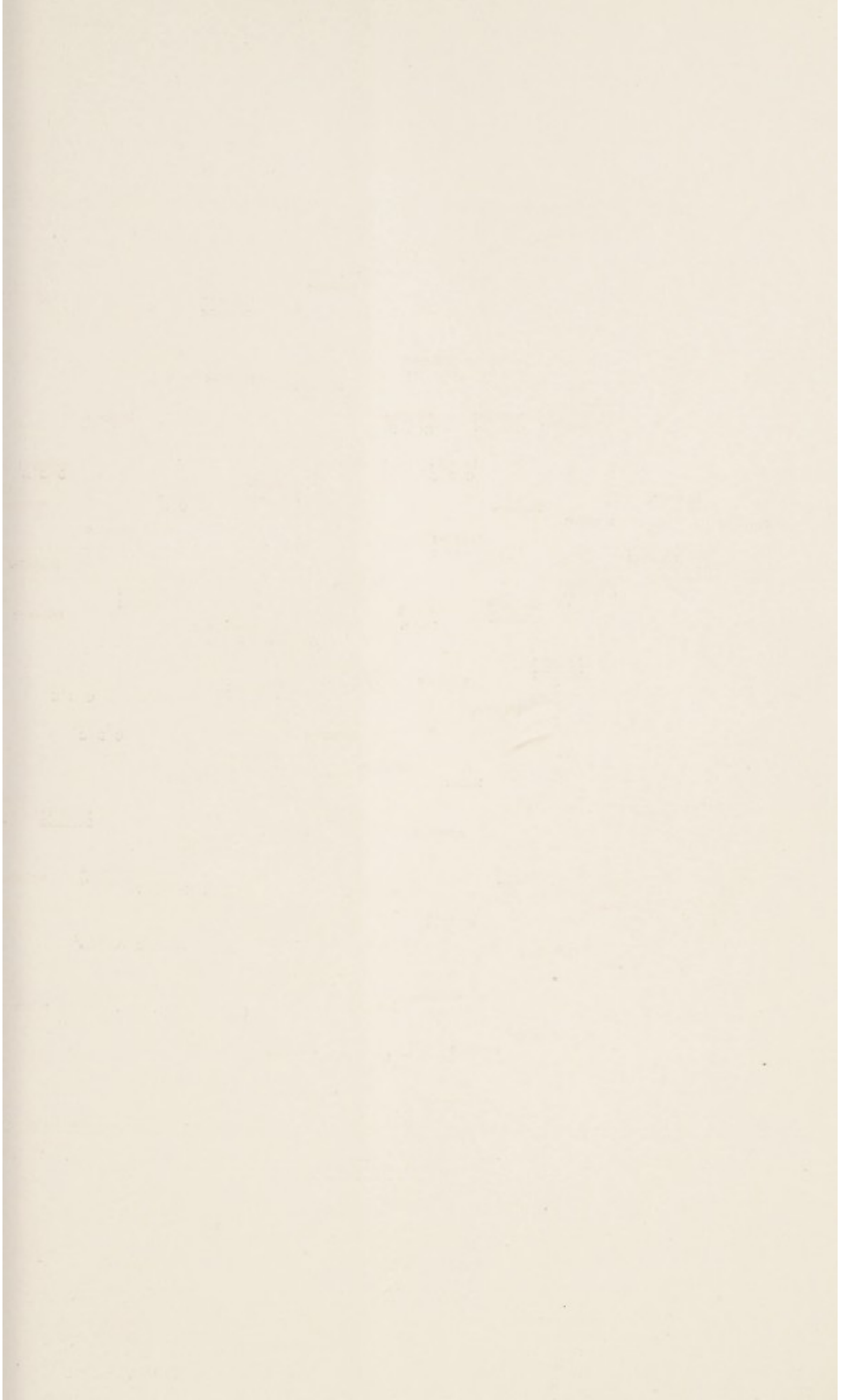


PLATE II.



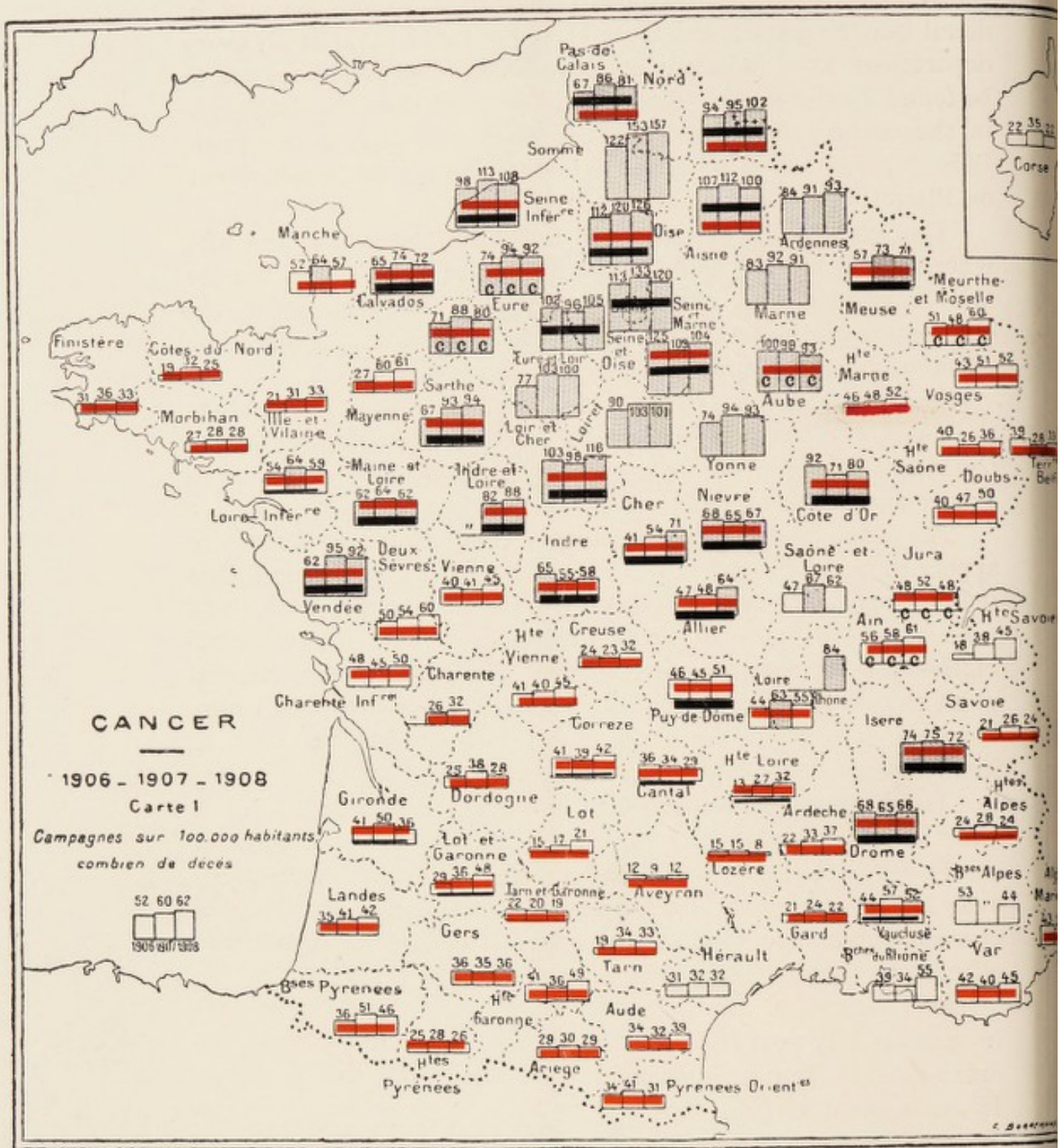


PLATE III.

Interesting as the town death-rate is, the country death-rate is even more striking. The extent to which wood is burned in the country districts in France is surprising when one goes in detail into the matter, and Plate II. shows that in practically every department wood is largely employed. All the exceptions are to be found in the north, where it will be seen that the death-rate in the country districts almost approximates that of the town. Indeed, in certain of these districts the country death-rate shown on Plate I. is actually higher than the town.

The explanation of this is, to my mind, the simple one that where coal is burned, as it often is in country districts, on hearths and in grates which were originally built to burn wood, the elimination of the products of combustion of the fuel is much less effective, and the results are correspondingly deleterious.

Plate III., however, shows that where coal and wood are burned the death-rate is about the average. Where wood alone is burned the death-rate is much below the average in some cases, as in Lozère and Aveyron, less than quarter of the average.

The maps speak for themselves. There may here and there appear to be slight discrepancies, but it must be remembered that it is extremely difficult to get an inquiry such as this carried out, even at the expense of great time and trouble, with absolute mathematical precision. One cannot calculate out to a decimal point the proportions of wood and coal which are used, but I have done my best to tabulate the information which has been so kindly given me, and which varies from such a general statement as "*Indistinctement le charbon et le bois, mais principalement le bois,*" to the very elaborate statistics for which I am indebted to the Préfet of the department of the Seine. Taken generally, however, I feel convinced that the maps bear out the fact that the character of the fuel used in any particular district has a profound effect upon the incidence of cancer.

As I have said, cancer seems to be practically non-existent in some purely peat-burning districts in Scotland, whereas the death-rate is almost invariably high wherever coal is burned. It was a great surprise to me to find it very prevalent in certain districts in Orkney where nothing but peat was burned, until I learned that this peat contained nearly one per cent. of sulphur, and was coal-like in character.

The exception often proves the rule, and I venture to think that my present study of the cancer incidence of France has proved the truth of the old adage. It will be noticed in Plate I.

that in the south of France the departments of Cantal and Aveyron burn almost exclusively coal in the towns. The Préfet of Cantal writes as follows:—

“Le charbon de terre est habituellement employé comme combustible dans les villes et le bois dans les campagnes.”

The Préfet of Aveyron writes:—

“1. Dans les campagnes : le bois presque exclusivement.

“2. Dans les villes le houille.”

This, at first sight, seemed to me unaccountable in view of the other results, but the Préfet of Cantal most kindly agreed to send me specimens of the coal used for domestic purposes in the district. This coal, like the Orkney peat, was a surprise.

It is a beautiful, hard, glistening, jet-like substance, apparently without any impurities such as pyrites, and totally unlike the coal which we are accustomed to. On analysis it showed the same sulphur content as the peat from Nistaben and Ardclach in Nairnshire, where cancer is very rare, viz. one death out of forty-two from all causes.

Some other element than the strictly sulphur content may be involved in the relationship of certain fuels to the cancer death-rates of the districts in which they are used. Some chemical condition of the fuel, its ash, or its other products of combustion may be responsible, but the results of such inquiries as I have made into the fuel conditions of those districts where cancer is rife seem to me to point conclusively to the fact that the etiology of malignant disease has some subtle connection with fuel and its products of combustion, a connection which lies somewhere about the difference between wood and charcoal, and between the coal of Aveyron and Cantal and that of the north of France.

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Strophomena setulosus France (Paris Herb) h. 32
 " *prospiciens* " (A.M. 2066) h. 33
 " *atkinsoniana* " (D. M. 2067) h. 33
 " *foliata* " (D. M. 2067) h. 34
 " *desfransi* (M. 2073) h. 36
 " *maculata* France K. 183 h. 36
 " *parvica* France BM 425 h. 38
 " *subgrisea* France A.M. 2105 h. 40
Physarum leucophaea France A.M. 2185 h. 44