SCIENCE

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THE AIR OF LARGE TOWNS.

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DURING the past three years a series of investigations have been in progress in England with a view to ascertain the composition of the air in populous districts under varying meteorological conditions. The Royal Society, the Royal Horticultural Society and the Manchester Field Naturalists have assisted the work by grants towards the cost of the requisite apparatus, and your readers may be interested in the results which have been obtained, although, of course, it is only possible to give a very brief summary of them. General experience has shown that evergreens cannot be grown in the heart of our larger cities and even the more hardy deciduous trees make little progress and sooner or later succumb. The sulphurous and other noxious vapors and the deposits of soot, hydrocarbons, etc., which form on the leaves are the chief agents in the destruction of plant-life.

Moreover, during periods of fog, when the air is surcharged with such impurities, the amount of sickness and the death-rate increase very considerably, especially in regard to diseases of the respiratory organs. The death-rate indeed from such diseases after foggy weather frequently increases to three-fold its normal value and is always exceptionally high in the densely populated districts.

Seeing that very few analyses of town air have been made embracing impurities such as sulphur in its various combinations and organic matter, attention was particularly devoted to these. And, indeed, setting aside the import of such forms of pollution from a sanitary point of view, the variations in sulphur compounds and organic matter may well be taken as means of differentiating between town and country air and of comparing together the condition of the atmosphere in different districts of a town. The method of procedure was to establish in London, Liverpool and Manchester and their suburbs a number of observing stations where determinations were periodically made of the composition of the air, of the character of the rain and snow and of the intensity of light. Comparative measurements were also at times made in country districts and in parts (such as Switzerland) where the air is of a great degree of purity.

From a very large number of observations I may summarize as follows:

(1) Country air and the air of the less populous parts of towns under the most favorable conditions show an amount of sulphur existing as sulphurous and sulphuric acid, etc., equivalent to not more than one volume of sulphurous acid per ten million volumes of air.

In populous districts this was found to rise to ten volumes *as a general average* in the Winter months and about five in the Summer. During dense fog such as occurs with tolerable frequency during the Winter, the amount recorded has been from thirty to fifty volumes. Whilst, therefore (as already found by previous observers), the carbonic acid gas during foggy weather is only about double that ordinarily occurring, the sulphur compounds accumulate so as to reach from twenty to fifty-fold their normal amount.

(2) Increase of a similar order was found to take place in the suspended organic matter of the air, and not only so, but the increase in amount, especially in closely crowded districts, was associated with a greater virulence.

A critical examination was also made of the nature of the deposits carried down during foggy weather, and as an instance I may give the composition of sample collected at Chelsea (London).

Carbon, - - -	39	per cent.
Hydrocarbons, - - -	12.3	"
Organic bases (pyradines), -	2.0	"
Sulphuric acid, - - -	4.3	"
Hydrochloric acid, - -	1.4	"
Ammonia, - - - -	1.4	"
Metallic iron and magnetic oxide,	2.6	"
Other mineral matter, chiefly silica, and ferric oxide, -	31.2	"
Water - - -	not determined.	

(3) With regard to the prevalence of black fogs we are fortunate in having records (kept by Dalton) which indicate that in the earlier part of this century, Manchester, with a population at that time of about 120,000, had on an average about four or five dense fogs during the winter, whilst at the present day (with a population of half a million) we have dense fog lasting the whole day on twenty days or more and fogs of less density are experienced on forty or fifty days.

The number and nature of the fogs vary, of course, according to the season, but this may be taken as a general expression of the state of things now.

(4) Measurements of the extent to which the actinic rays are cut off by smoke and haze show that the central areas of our large towns suffer a very large diminution, amounting to a loss of from thirty-five to fifty per cent as compared with the suburbs. That these suburbs are themselves by no means removed from the influence of smoke is evidenced by the fact that under like conditions the values obtained at Torquay and at Grindelwald in Switzerland were three-fold and six-fold, respectively, of those given for the suburbs of London and Manchester. In foggy weather ninety-five per cent or more of the actinic rays are cut off.

(5) Determinations of the number of bacteria and moulds occurring in the air show that again in this respect, also, the contrast between town and country air is very marked indeed, and that in all such determinations due allowance must be made for the meteorological conditions prevailing at the time of experiment. The effect of impurities, such as sulphurous acid on micro-organisms, is also being studied.

Though in the previous paragraphs it has only been possible to deal in the most general manner with the results obtained, the remarks will, I hope, be sufficient to give point to a request that I should like to lay before your readers.

Smoke arising from the combustion of coal is undoubtedly the primary cause of the pollution of town air either directly or indirectly; directly in its contribution of sooty matters, hydrocarbons, sulphurous acid, etc., and indirectly in promoting a condition of the atmosphere in which free diffusion is very much interfered with and leading therefore to the accumulation of sewer gases and emanations from decaying refuse in the lower stratum of air. The substitution of gaseous fuel, though it may not get rid of fogs altogether, will doubtless mitigate in a very large measure their noxious character and in the era when lighting is done by electricity and heating by gas the whole aspect of our towns will be changed for the better. We have, however, no wide experience in this country to which to point as an object lesson in such a direction. In the United States gaseous fuel has been much more freely applied, and there are, I understand, instances in which coal has been almost entirely superseded by natural gas. If any of your contributors could say how far this is the case and give some idea of the effect which such a change has produced on the air of the locality and on the aspect of the town in question, a signal service would be rendered and a distinct advance would be made in the direction of banishing the fog demon once and for all.

THE UTICA SHALE IN STEPHENSON COUNTY, ILLINOIS.

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In the various reports of the Illinois Geological Survey all the strata from the top of the Galena Limestone to the base of the Niagara have been classed together under the term Cincinnati Group. So far as northwestern Illinois is concerned this was probably the only classification possible from the limited data at hand. As a general thing only the upper half of the formation was seen in open section, as this is the only part ever quarried into, and natural sections of Cincinnati strata are rare in this region. But a few do exist in the southern and southwestern parts of Stephenson County, which show the lower strata of the shales, and from an examination of these, together with quarries and railway cuttings, the following section has been prepared:

Generalized section of the Cincinnati Group in Stephenson Co., Illinois.

Niagara Limestone.

Light brown, argillaceous, thin-bedded limestone, and white chert. Transition to Niagara, and counted with it. - - - - - -	10 ft.
1. Calcareo-argillaceous shales. Buff and gray, with irregular patches of blue. Generally unfossiliferous. - - - - - -	50 ft.
2. Light brown, crystalline, dolomite layers, and soft, yellowish shales. Fossils very abundant. -	15 ft.
3. Coarse-grained, calcareo-argillaceous shales. Light brown and red. Dark brown laminated shales alternating with lower layers. No fossils. -	20 ft.
4. Dark brown, argillaceous, finely laminated and very fissile shales. No fossils. - -	5 ft.
5. Same as above, except light brown in color.	3 ft.
6. Stratum containing much reddish-brown powdery iron oxide. - - - - -	6 in.
7. Yellow granular shale. - - - -	8 in.
8. Dark brown shales made up largely of comminuted shells. Fossils. - - -	4 ft.

Galena Limestone.

Since the remarkable discovery of oil and natural gas in the Trenton limestone of Ohio and Indiana, and the consequent discovery that the Utica shale of the New York section is present in the two states mentioned as a well-marked bed of dark brown shale, the writer has thought it probable that the Utica shale, *in its normal condition*, would be found to make up a part of the Cincinnati strata of northwestern Illinois.

Many of the "mounds" of western and southern Stephenson County are capped with a few feet of Niagara limestone, but the main body of the elevation is made up of the light colored shales or shaly limestones aggregating fifty feet in thickness, and numbered one in the section. This is certainly not Utica, but agrees pretty well in stratigraphic and lithologic conditions with the Hudson River shales, as developed in southern Ohio. The evidence is still stronger for the Hudson River age of the underlying fifteen feet of light colored shales containing numerous limestone layers, literally covered with fossils, which, so far as I know, are of typical Hudson River species.

The preceding strata are of a generally light color, but in No. 3 dark colors begin to appear. It is probable that wells drilled through the Cincinnati strata in this region would be reported as passing through sixty-five feet of light colored shales, then through twenty feet of gradually darkening beds, and finally about fourteen feet of dark brown shales. This agrees with well-section reports from Ohio, differing, however, in the thickness of the strata.

No. 3 is so coarse-grained as to resemble sandstone, but on dissolving the calcareous matter with acid the grains are found to be composed principally of clay. These gradually grow darker towards the base, and thin strata similar to No. 4 appear, alternating with the red sand-like shales. No. 4 is a very characteristic stratum of non-granular, finely laminated dark brown shale, weathering to a light blue color, and breaking into small flat pieces, as does the Utica shale of the Atlantic slope.

No. 5 is similar in constitution, but is somewhat lighter in color, weathering to buff. The thin stratum containing the bright colored powdery iron oxide appears to be made up largely of dark colored clay, but is not well exposed. The underlying yellow shale is similar to parts of No. 1, containing some irregular patches of blue, and seems out of place among these dark colored shales.

But now we come to the most remarkable of all—a four-foot stratum of dark brown shale, made up largely of fragments of small shells, irregular masses of iron disulphide, small rounded concretions of a slaty color, and dark brown or black mud. Only one variety of shell remains in an unfractured condition, and this is probably some species of Singula. These dark shales lie on a series of buff colored shaly limestones, also largely made up of comminuted shells, but which is undoubtedly the upper portion of the Galena Limestone.

The dark brown shales, Nos. 4 and 8 of the section and included lighter colored strata, are apparently stratigraphically and lithologically similar to the Utica shale as developed in Ohio and Indiana, and although this terrane in the latter state has been shown to thin rapidly towards the west, it is considered quite probable that it does not entirely disappear at least as far west as the region under discussion, viz., Stephenson County, Illinois.

While the lower thirteen or fourteen feet of the so-called Cincinnati shales of this region are considered to be truly of Utica age, the succeeding twenty feet of shales, No. 3 of the section, may be transition strata to the Hudson River shales, which certainly have set in in characteristic form by the time the base of No. 2 is reached.

There is evidence tending to show that some of the beds, especially Nos. 7 and 8, thin out and totally disappear in portions of the field, also that the dark brown laminated shales, No. 4, thin out towards the west and south, and perhaps the entire dark colored portion of the series disappears before reaching the Mississippi River. There seems to be an interesting field for future study in this portion of the Mississippi Valley, and some curious problems to solve.

This preliminary note is published in the hope that sections showing the lower portion of the Cincinnati shales in other counties of this and neighboring states will be reported for comparison in order to determine the boundaries of each distinct formation, and the changes which they undergo in passing from one region to another, which is absolutely necessary for the proper understanding of the early Silurian history of what is now northern Illinois.