

Racey

1860

*Certain Deposits of Pigment
their Causes, Sources and
Chemical Characters.*

Deposits of Pigment

The term, "Deposits of Pigment" admits of a very wide interpretation; as, it may be applied to the various collections of that substance, which, using the word in a general sense, exist diffusely scattered amongst the various creatures & plants of which the animal & vegetable kingdoms are composed; but as, circumstances will not permit of my writing on so extensive a topic; & as, strictly speaking, in Histology, pigment cells mean those in which a black or brown coloring matter is deposited; I shall confine my remarks to the principal deposits of true pigment as they are found to exist in man.

Collections of Pigment in larger or smaller quantities are found in various parts of the human frame; the principal of which may be said to be the skin, lungs & choroid membrane of the eye;

Quain's Anatomy 4th Ed. Vol 1.

but they may exist in every variety of locality, & Prof Bennett in his lectures; says, "I know of no cells which under certain circumstances may not have pigment deposited in them".

This colouring substance is seldom found without being more or less associated with fat; as, for example, the skin of the negro which abounds in sebaceous glands; & hairs which are well supplied with fatty matter from the glands existing at their roots. Pigment may be deposited as free granules which do not generally exceed $\frac{1}{20,000}$ of an inch in diameter; or in cells which vary in form & size.

There seems no reason to doubt that in most cases pigment cells are produced like other cells, viz, from a liquid organic matter or blastema, & when the circulation of the blood is once established in the animal system, the liquor sanguinis may be regarded as the general source from

whence the organizable matter for the formation of these cells is obtained; elementary granules appear in this fluid; several of these join together & a nucleus is produced; externally to this a cell wall is created; & then, nucleolus go on forming between the cell wall & nucleus until the pigment cell is completed.

After these few preliminary observations the consideration of the principal deposits of pigment may be entered upon; & the first & most abundant may be said to exist in the integumentary structures of the different races of the human family; in largest quantity in the skin of the negro; in comparatively small quantities in that of the white man; yet in certain parts of his cuticle it abounds; as, on the areolae & nipples which sometimes are of a blackish brown colour; especially in women who have borne children & also during their pregnancy; in the scrotum, penis, axillae, around the anus &c.

Quackitts Histology Vol. 1.

Quackitts Anatomy 6th Ed. Vol. 1.

Sometimes it is deposited in large quantities on the face; as, in the case of a young woman under whose right eye pigment appeared in such quantities, that it was capable of being brushed off with a camels hair brush.

The different degrees of colour presented by various races of men are due to the relative amount of this substance which is found in the epidermis only, & does not extend into the cutis vera; but in the case of albinos a total absence of pigment is met with, not only in the skin; but in all other parts of their organization. The pigment of the cuticle is deposited as a finely granular matter, in its cells; or, in proper pigment cells which resemble those found in the choroid membrane of the eye in almost every respect save; their size, which is somewhat less; it is in greatest abundance in the rete mucosum,

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or deep layer of the skin, & is darkest in colour around the papillae of the cutis vera; as the cells containing it are pushed out to the surface of the body (during the process of desquamation which is continually going on) it undergoes a change & loses its colour; each pigment cell contains a colourless nucleus & nucleolus, & between the cell wall & nucleus a number of dark coloured molecules with an interspersed colourless matter; the cells vary in size from the $\frac{1}{800}$ to the $\frac{1}{1000}$ of an inch in diameter; colourless cells are found interspersed with these pigment cells.

Some physiologists affirm that the dark colour of the skin is due to the presence of cells in the rete mucosum that have dark brown nuclei, the substance of the cell being likewise tinged, the colour being thus spread throughout the mass contained within the cell; & therefore not caused by distinct coloured molecules;

Höllickers Manual of Human Histology

Quain's Anat. 6th Ed. Vol. 1.

but, as it is generally admitted that pigment granules have a tendency to congregate around their respective nuclei, it is most likely that the first of the above statements is correct.

The only difference that appears to exist between the pigment cells found in the epidermis of the negro & those deposited in the skin of the white man, is, that the former are larger than the latter.

Pathological colorations of the epidermis, such as freckles, moths marks, &c, according to Simon, Krause, Pärnsprung & Hölleker, are produced exactly in the same manner as the more intensely coloured spots in the white man; & as the colour of the negro skin.

The colouring matter of a hair is usually found in its fibrous substance; but when a medulla or pith exists in it, a greater quantity of pigmentary matter is found therein than in

Quain's Anat. 6th Ed. Vol. III.

the fibrous layer; the fibrous substance is translucent, & is composed of flattened cells of a fusiform outline; the colour of this substance is due to oblong patches of pigment granules, contained within & without the cells; generally diffused colouring matter of less intensity; & also to minute irregularly shaped cavities containing air.

The medulla or pith which occupies the centre of the shaft & ceases towards the point of the hair is more opaque & deeper coloured than the fibrous part, & seems to be composed of clusters of cells more or less angular in form, containing minute pigment granules; some very fine fat molecules; & a great many air particles.

It is thus that hair is coloured, & accordingly as these deposits vary in hue or quantity; so in proportion is the colour of the hair affected..

Pigment is found in larger or lesser quantities in the lungs, scattered

throughout its substance, existing in greatest abundance in the interstitial areolar tissue near the surface of these organs & in the bronchial glands; sometimes it is found in the air cells or around the vessels of the lungs.

The amount of this colouring matter increases with age; so that the tint of the lungs of an individual which are in infancy of the ordinary pale rose pink hue, may in old age become uniformly black on the surface.

Dr Guillot of Paris physician to the hospital for aged people says;

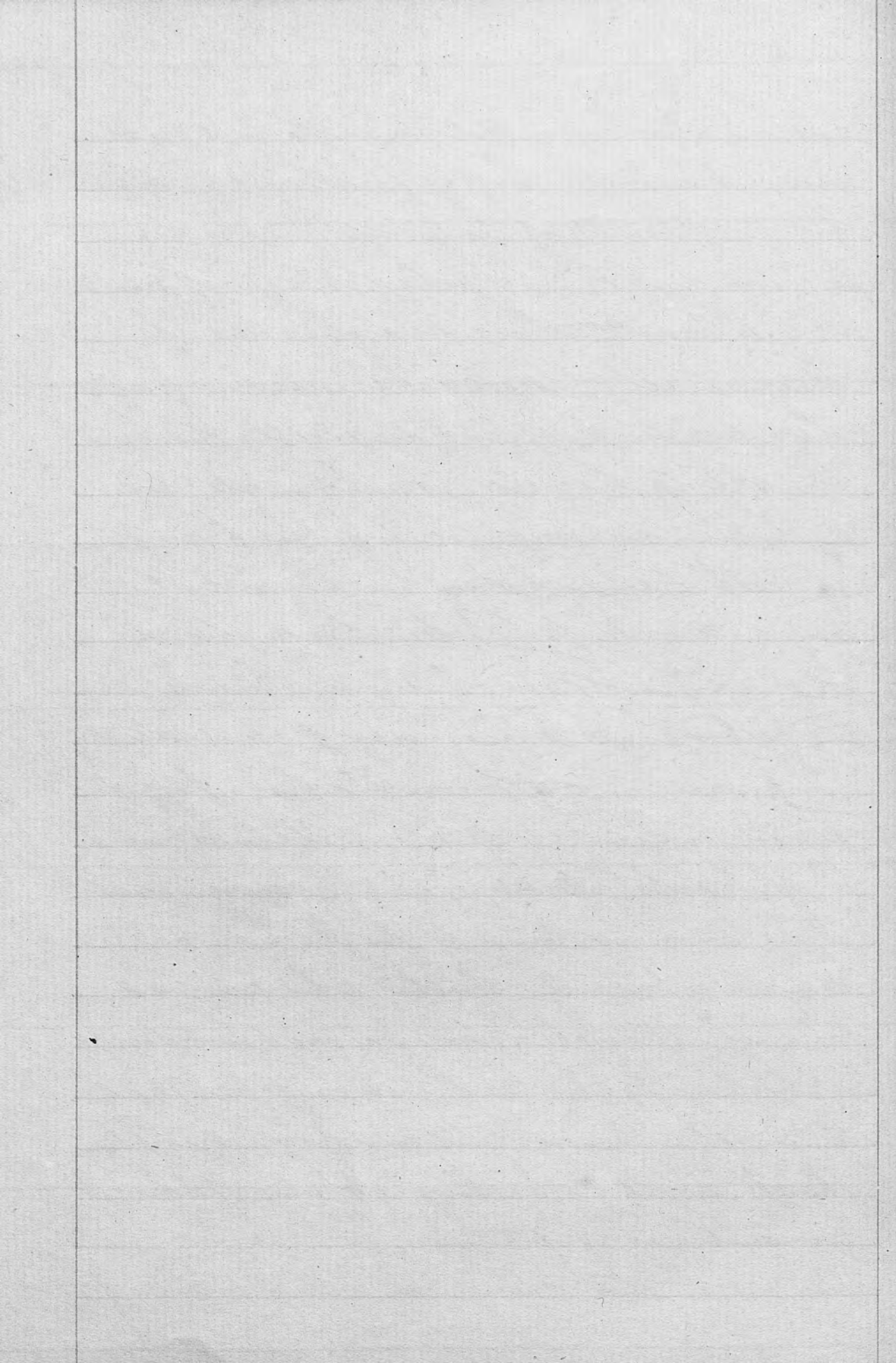
"There is scarcely an individual of advanced life, who does not present the carbonaceous deposit in the lungs, generally most marked at the apex, the carbon often exists in crude masses, obliterating the vessels & bronchial tubes."

This pigment is found especially in the lungs of persons following the occupation of colliers or miners, & is

Bennetts Prin. & Pract. of Physic.

not usually deposited in cells but as granules or collections of granules; & in some forms of disease of the lungs these organs are intensely charged with black matter. Prof Bennett thus describes the appearance of the carbonaceous lungs of individuals who have died from the effects of False Malaria; he says, that, on examining the lungs of such persons they are found to present a deep black colour, which is most intense towards their apices. On section, the pulmonary tissue yields on pressure, a copious black ink-like juice, which stains all surrounding objects, attaches itself to inequalities on the skin of the hands, & insinuates itself under the nails like fine black paint; at the apices of the lungs the pulmonary tissue is generally more or less condensed, & the black matter thicker & often of the consistency of putty.

In advanced cases, ulcerations &



cavities exist, exactly resembling in all their characters those of phthisis, with the exception that no tubercle can be discerned & that the whole is of an intense black colour.

Occasionally, black indurated & gritty masses can be felt & dug out, which in some rare cases present a slight crystalline structure like coal or crystalline carbon.

On placing some of the black fluid squeezed from the lung under a microscope, & examining it with a power of 250 diameters linear, it is seen to consist of a multitude of black molecules of extreme minuteness, floating in a liquid, here & there may be observed epithelial cells, loaded with black carbonaceous matter; in some of them the nuclei are evident, the matter being deposited between them & the cell walls; in others the nuclei are quite concealed.

Principles & Practice of Medicine J. Hughes Bennett

Quains Anat. 8th Ed. Vol. 1.

A thick investment of pigment is found deposited in cells on the choroid membrane of the eye, which is rendered black through their agency; these pigment cells are for the most part polyhedral in figure, generally six-sided & connected together like the pieces of a mosaic pavement; others are spheroidal, & most of those on the back of the iris are of that shape. The cells contain the pigment which consists of minute black or brown granules or molecules of a round or oblong shape measuring not more than from the $\frac{1}{17000}$ to the $\frac{1}{24000}$ of an inch in their greatest dimension. These molecules are densely packed together in some cells; in others, they are more scattered, & then it may be seen that there is a certain amount of colourless matter included along with them.

When they escape from the ruptured cells, they exhibit, very strikingly, the molecular movement, & in consequence

Carpentus Physiology.

of this movement, the apparent shape of the particles is subject to change; when viewed singly, with a very high magnifying power they look transparent & almost colourless, & it is only when they are heaped together that their blackness distinctly appears.

The cells have a colourless nucleus which is generally hidden from view by the black particles, it contains a central nucleolus.

The causes that induce a development of pigment in the skin are of various kinds but may chiefly be said to be due to the effects of climate, disease & food.

It would appear from a general survey of the complexions of different races of men that the climates they respectively inhabit, have had a decided influence in deepening or lightening the colour of their skins; & the conclusion to be drawn from such a survey, is, that the intotropic

cal region of the globe is the principal seat of the darkest races of men; the regions remote from the tropics is that of the fairer races; & the intermediate climates are usually inhabited by those having an intermediate complexion.

High mountains & countries of great elevation are generally inhabited by people of a lighter colour than those whose situation is low, & who dwell in swamps or sandy plains, or near the sea coast.

In Africa these distinctions are well seen; the tropics there almost exactly mark out the boundaries of the black complexion of the inhabitants, & the darkest hue is found to exist amongst those negroes who inhabit the Guinea Coast, & who are influenced by both the conditions above mentioned; but the mountainous regions in their immediate neighbourhood are inhabited by tribes who have not acquired such a deep tint.

Watsons Prin. & Pract of Physic.

The effect of climate in lightening the colour of the negro skin is also well seen in the cases of runaway slaves who have come to Canada from the Southern States; as, by degrees their integuments assume a lighter hue than they originally possessed; & the children of such individuals are again of a lighter shade than their parents, & that in cases where there has been no intermarriage between the white & black races. In speaking of disease as a cause that induces deposits of pigment in the cuticular structures I would in the first place refer to True Melanosis, which, consists in a morbid product of a black or deep brown hue, varying in its degrees of intensity; generally moist, unorganized & differing in the form it assumes, & in its consistence, according to circumstances; these black deposits take place most frequently in the axillae

& adipose tissues; & thus contrast with the manner in which normal pigment is deposited in the skin; they vary in abundance & are in proportion to the relative amount of these tissues, & are also found in the compound organs of the body; especially the liver; sometimes in the lungs, eyes & brain; & in mucous membranes; but very seldom in serous membranes. This black matter may exist in a liquid condition in the natural cavities of the body (but this is very rare) & is sometimes mixed up with scirrhous & hairy like malignant tumours.

The surfaces on which this matter is deposited sometimes look as if they had been thickly sprinkled over with coal dust or soot; but more frequently it assumes the form of solid tumours of sizes varying in degree, from that of a pin's head to an orange. This black product when exami-

ned microscopically is found to consist of minute granules, or irregular masses, scattered throughout a tissue, & these granules may be contained in cells which vary in shape, the nuclei in these cells are sometimes clear & colourless; at other times they are obscured by the black pigment.

Dr Addison, in his work on diseases of the Supra Renal Capsules, has called attention to the discoloration of the skin, owing to deposits of pigment, which frequently attends disease of those organs, & says; that, the cuticle may be said to present a dingy or smoky appearance, or various tints & shades of a deep chestnut brown, & in the case of one patient under his care, that the skin was so universally & so deeply darkened, that, but for his features the man might have been mistaken for a mulatto; he goes on to say that this irregular distribution of pigment cells, is not

confined to the skin; but is occasionally met with in some of the internal structures, & that it has been seen in the form of black spots beneath the peritonium of the mesenteric omentum.

The peculiar food on which the Esquimaux tribes & Greenlanders who inhabit the northern regions feed & which consists principally of carbonaceous fat & oleagenous substances has been assigned by some to be the agent that causes the dark appearance of their cuticles.

The causes which induce deposit of pigment in hair are not apparent; but grief & intense mental anxiety may be said to be active agents in producing transitions in the colour of hair; cases are on record in which in ^{the} course of a single night hair of a dark hue has been turned completely white; these sudden changes are supposed to be due to an acid substance being formed which destroys

Bennetts Prin. & Pract. of Physic.

the colouring matter of the hair.

In old age the hair becomes grey or white owing to the secretion of pigmentary matter being decreased.

The causes that induce a deposit of pigment in the lungs & the sources from whence it is derived are still unaccounted for.

Dr Pearson however thinks that we are always insensibly breathing an air more or less loaded with smoke the results of combustion, & other impurities & that this of course accumulates the *adulterum*.

If this opinion were true, large deposits of carbon should be more common in persons who inhabit densely populated & manufacturing towns such as London, Liverpool, Manchester & Glasgow, yet we do not find this to be the case.

The air in Paris is remarkably pure, the fires of manufactures are few & yet there, according to Guillot car-

brownish deposits in the lungs are commonly met with.

It may be that these deposits are formed internally in all cases, by a chemical process, & that their formation is to be ascribed rather to the inhalation of Carbonic acid gas than to Carbon in a minutely divided state inspired from without.

Perhaps both these causes may assist in producing deposits of pigmentary matters in the lungs.

The cause that induces the formation of pigment on the Choroid membrane of the eye, considered apart from being a wise provision of the Creator who has thus produced a structure with certain definite objects in view does not yet appear to have been ascertained, but the reason of its deposit would seem to be for the purpose of absorbing those rays of light which pass through the transparent retina

& thus to prevent their being thrown again ^{up} that membrane so as to interfere with the distinctness of the images there formed.

Hence animals in which the choroid is destitute of pigment & human albinos are dazzled by daylight & retreat in the twilight. The pigment found in the skin would appear in some cases a peculiar modification of the blood; in others of the fat; or it may be looked upon as a secretion derived from the blood, in the same manner; as ordinary secreting cells attract & select from the blood those elements which are transformed into the peculiar contents of their respective cells.

The coloring matter of the hair is secreted in the base of the hair follicle, & is brought out from thence as the hair grows; it first makes its appearance in the cells from which the

Lehmanns Physiolg. Chem.

Quain's Anat. 8th Ed. Vol. 1.

hair is produced & which are formed from a blastema thrown out on the surface of the papilla, which occupies the bottom of the hair follicle.

Saunders was unable to discover any special pigment in the hair; but proved by many experiments that, the iron, which is present in differently coloured hair, exerts no influence whatever on its hue.

The large quantity of iron contained in the *pigmentum nigrum* of the eye, would seem to indicate, that, it, takes its origin from the haematine of the blood, which, according to Mulder consists of

Carbon	65.84	per cent
Hydrogen	5.37	" "
Nitrogen	10.4	" "
Oxygen	11.75	" "
Iron	6.64	" "

As, it cannot be doubted that the colouring matter of the skin, is the same in its essential nature, as,

Lehmanns Phys. Chem.

that of the choroid membrane of the eye; & as the hair is only a modification of the cuticle; I shall by describing the chemical characters of the Melanin of the Choroid membrane of the eye make one description suffice for the chemistry of the pigment of the three tissues.

Schuman states; that when Melanin is obtained as a separate substance from the choroid membrane of the eye, it forms a black coherent mass, or a blackish brown powder; it is devoid of smell & taste; is insoluble in water; ether, alcohol, dilute mineral acids, & concentrated acetic acid; it dissolves after prolonged digestion in dilute solutions of potash, from which it is again precipitated by hydrochloric acid; it is decomposed when boiled with concentrated nitric acid; but is not affected by even the prolonged action of chlorine; it is a conductor of electricity; is incapable of

Kirk's Phys.

firing; may be ignited in the air & burns with a vivid light, the charcoal continuing to smoulder, till it is reduced to a whitish yellow ash, consisting of Chloride of sodium, lime, bone earth, & a little peroxide of iron.

According to Emelin, this pigment is rendered paler, & is partially dissolved by chlorine water, the undissolved portion becoming again of a dark brown colour on the addition of potash, & Beddoes says that he saw the arm of a negro become pale for a short time when immersed in Chlorine gas.

The principal elementary substances composing this pigment, according to an analysis made by Scherer, were found to exist in the following proportions,

Carbon	58.27
Hydrogen	5.97
Nitrogen	13.76
Oxygen	21.98

Bunnells Prin & Pract. of Physic.

Vogels Path. Anat.

The chemical characters of pigment found in the lungs vary; but, the normal deposits, seem to be a carbonaceous mixture consisting of carbon & some animal matter; a similar black substance is found in the bronchial glands.

The pigment, however when existing in such quantities as to form a morbid product, is in one case found to lose its colour on the addition of nitro muriatic acid, or chlorine water, while in other instances it resists these agents & even the action of the blow pipe.

It is found, that the intensely black pigment of malarious lungs & bronchial glands rendered as pure as possible by boiling in hydrochloric & diluted nitric acids, & then extracting with water, ether, & alcohol, was insoluble in sulphuric, hydrochloric acids, caustic ammonia, potash & dilute nitric acid; it dissolved only

in concentrated nitric acid; at the same time undergoing decomposition; it was not decomposed by chlorine, though Bruck asserts to the contrary; he goes on further to say, that,

Dr Schmidt had analysed two portions taken from different bodies which appeared to correspond in their chemical relations & in their actions towards the above reagents with the pigment referred to; the first was taken from the melanotic lung of a minor in Chausthal & gave after the deduction of 12.48 of ashes consisting 10.6 silica (pulverised quartz) & 1.88 sulphate of lime

Carbon	72.95
Hydrogen	4.75
Nitrogen	3.89
Oxygen	18.41
	100.00

In the other experiment on a lung hepatised inferiorly & whose bronchial glands were thoroughly melanotic

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the determination of the hydrogen could not be regarded as certain, in consequence of the smallness of the quantity subjected to analysis; it gave after the deduction of 3.735 of ash consisting of silica (powdered *opieante*)

Carbon	66.77
Hydrogen	7.33?
Nitrogen	8.29
Oxygen	17.61
	100.00

These two analyses show but little similarity; it would appear from these that this kind of pigment has a variable composition; they also prove that the opinion, that the pigment deposited is pure carbon is in these cases incorrect, & they show that this material is not the same as the normal pigment of the eye.

In Dr Gregory's case of black infiltration of the lungs, the washings of the lungs containing much of the black serum were analysed by

Dr Christison, who obtained the following results;

1st Concentrated nitric acid boiled on it did not alter the colour;

2nd Immersion in a strong solution of chlorine had no effect.

3rd A strong solution of caustic potash boiled on it took up some animal matter & filtered very slowly; the first part that filtered through was opaque & black; but the last portions were of a pale yellowish brown colour & transparent, so that none of the black matter was dissolved; the black matter remained on the filter & this well washed & dried burned like charcoal powder, without swelling up & with scarcely any emphysema, leaving a considerable pale grey ash.

4th A small portion of the black powder left after the action of boiling nitric acid was well washed, dried, & introduced into a minute glass

ball, with a tube attached which was subsequently drawn out by means of the spirit lamp flame to a fine bore.

On the application of a low red heat to the ball there was disengaged at the open end of the tube a considerable quantity of gas, which had the odour of coal gas, & on the approach of a light, took fire & burned with a dense white flame; in the tube a dark yellow fluid likewise condensed, which had very exactly the odour of impure coal tar naphtha, & became a soft mass on cooling, of the consistency of lard. This when compressed between layers of filtering paper, yielded an oily stain to the paper, & left a white matter which dissolved in boiling alcohol & separated again on cooling, in the form, of minute obscure crystals.

In the products of this experiment it is scarcely possible not to recognize

Trans. of Med. & Chir. Soc. London Vol. 21.

the ordinary products of the distillation of coal; a gas of the same quality was procured & likewise a naphthous fluid, holding in solution a crystalline principal analogous if not identical with naphthalin. Dr Henry on examining a portion of melanotic matter from a case of true melanosis obtained the following results,

- 1st By filtering through paper much of the colouring matter remained on the paper & the colour of what passed through was much less intense.
- 2nd Boiling does not destroy the colour; not even when a little caustic potash has been added.
- 3rd It is not changed by acids even when heated except by nitric acid which deprives it of its black colour & turns it yellow.
- 4th A stream of chlorine passed through the liquid destroys the

black colour & throws down light fawn coloured flocculi.

5th A few grains of corrosive sublimate stirred up with the fluid, precipitates the whole of the colouring matter & leaves the supernatant liquid quite clear.

6th Nitrate of mercury acts in the same manner; but more tardily.

7th Muriate of tin produces the same effects; but more slowly than corrosive sublimate.

I now in bringing this paper to a close I have to regret that time & opportunity have not permitted of my entering more fully on a subject which is of much interest.

Yours &c
Jno Racey
March. 1860.