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MINUTE PARTICULARS

"POISONOUS BLUES," AND OTHER PIGMENTS

By Ruthven Todd

NOTE: Several years ago, in *Blake Newsletter* 28, we published a short piece by Robert M. Ryan on Blake's phrase "poisonous blue," concerning some of the chemical properties of the painter's pigment "prussian blue." Soon we received a letter from Ruthven Todd giving us his preliminary thoughts on the matter and promising, as Ruthven's letters always did, further thoughts in publishable form. After his death in 1979, the following unfinished draft was found among his papers. THE EDITORS.

DRAFT 28 DE NOVIEMBRE DE 1974

As a consistent contributor to "Minute Particulars" I feel somewhat abashed in querying or even contradicting any other contributor, so I hope that Robert M. Ryan will accept my apologies in advance.

For a man whose principal occupation has been that of a writer, I have spent a possibly unreasonable amount of my life experimenting with and using the tools and materials of the graphic artist. Abetted by my friends, particularly S. W. Hayter, Joan Miró, Fred Becker and the late Harry Hoehn, I have engraved and etched, learning how to handle a burin and how to behave with acids, for more years than I like to recall. Most of my interest in the techniques having been historical, I had never, until the spring of 1974 (when I made some experiments with Harvey Breverman and his associates at Buffalo) tried zinc or any other etchable material, such as magnesium or iron. So my experience practically, and visually, can be said to be that of a worker in copper.

The basic mordant used in the biting of copper is Nitric acid (HNO_3), prepared as follows, according to that standard work, S. W. Hayter, *New Ways of Gravure*, Oxford University Press, London, New York, Toronto, 1966, p. 57: "1 part nitric acid to 2 parts water. There should be some copper in the solution or the acid will not bite regularly. Some old acid may be added; or a copper penny dropped in for a few minutes until the acid is coloured blue. Nitric acid reacts with copper to produce bubbles of nitric oxide gas."

The virulence of this brilliant blue liquid, from which the fumes curl off, as the copper is bitten, in yellowish-brown purlings, has always suggested to me that this was the "poisonous blue" with which "They stain'd him" on Plate 65 of *Jerusalem*. I knew that the acid destroyed clothing easily and that my skin, over-dipped in the stuff, and inadequately washed, peeled off in vegetative or seaweed-like strips of autumnal coloring. I also knew that the fumes hurt my breathing during the long bitings which I used when experimenting with Joan Miró.

Now it seems to me that, firstly, since I will not live forever, and, secondly, the information should be immediately available, I should go beyond the assumption which I had, and give away whatever information I have at hand or can remember.

For a start, and in support of my belief that nitric acid was, indeed, the "poisonous blue," I have looked up and quote from W. F. von Oettingen, M. D., Ph. D., *Poisoning A Guide to Clinical Diagnosis and Treatment*, Second Edition, W. B. Saunders Co., Philadelphia, London, 1963, p. 454: "Nitric acid is a clear colorless, fuming, corrosive liquid, which upon contact with air and exposure to light turns yellow to brown-red because of formation of nitrogen oxide. [This, of course, makes no allowance for the bluing action of copper]. The reagent grade nitric acid [used by etchers] contains 68 to 70 per cent and the 'diluted' nitric acid, 10 per cent of nitric acid. Nitric acid is used in many industries and trades and in medicine as a caustic agent. Its contact with the skin causes yellow discoloration (xanthoprotein reaction), very painful inflammation, blisters, necroses, and gangrene. Prolonged exposure to the fumes of nitric acid causes discoloration and corrosion of the teeth. Splashes in the eye cause severe conjunctivitis, palpebral edema, ulceration of the conjunctiva and cornea, and subsequently turbidity of the latter. The inhalation of the fumes causes more or less severe irritation of the upper respiratory tract."

While "There is no chronic copper poisoning analogous to that of lead," it should be remembered that copper, particularly in its various combinations with other substances, is also a poison. When I was young and the modern pesticides or parasiticides had not yet appeared, those who were unlucky enough to be attacked by the crab louse, *Phthirus pubis* (which, according to *The Merck Manual*, Twelfth Edition, Rahway, N. J., 1972, p. 1457, *is* acquirable "from such objects as toilet seats, clothing, and bedclothes") used to go to a chemist's and buy, for a few pence, a jar of "blue ointment" with which to rout the invaders. This was Cupric Sulfate, also known as copper sulfate, blue vitriol and blue stone, and commonly understood to be a solution of copper in dilute sulfuric acid. While it is no longer listed as a cure for crabs, it still retains its place in *United States Dispensatory and Physicians' Pharmacology*, 26th Edition, J. B. Lippincott Co., Philadelphia & Toronto, 1967, p. 343, for, among other uses, its value in abolishing algae from swimming pools.

I think I have shown that copper, in combination with acids, is not only blue but also poisonous. I could, with access to a larger library than I have here in Spain, probably extend the matter, with gruesome details, but feel that to do so would be to attempt to blue the Mediterranean. Further, I cannot think of any liquid blue capable of staining

and also leaving the impression of vegetation, in the peeling strands of yellow-grown skin, which Blake could have meant except the nitric acid, colored with copper, which he used all his working life.

II

By chance it happens that the other blues, with two exceptions, which could have been known to Blake are reasonably innocuous. In this part, I am going to have to rely very largely upon that most important book, Rosamond D. Harley, *Artists' Pigments c. 1600-1835 A Study in English Documentary Sources*, London, Butterworths, 1970, and I am going to steal from it in the most unashamed way since it seems that my effort to say how important it is, in *Blake Newsletter*, 4 (August 1970), has passed unnoticed. All references to Harley are, unless specified as coming from personal correspondence, to this book.

To dispose, first of all, of the matter of Prussian Blue, I am going to give Dr. Harley's entry on this from her book, pp. 65-68. [In all my quotations from Rosamond Harley and, later, Geoffrey Grigson, I have omitted their references to their sources, not only because such an action saves space, but also because I think that students should also investigate them, as nobody knows what peripheral material may prove to be pertinent.]

> Prussian blue, potassium ferric ferrocyanide, has been described as 'the first of the artificial pigments with a known history and an established date of preparation'.[97] However, the idea that a definite date may be associated with it may be a modern misconception. It is true that the circumstances of its accidental discovery were reported by Stahl some years after the event and that his account has been referred to many times since, but it is noticeable that throughout the period up to 1835 every writer who mentions any date in connection with the pigment states that it was discovered *circa* 1710, whereas the date, 1704, given by so many later writers was not mentioned until the late nineteenth century. Earlier writers based the date on the knowledge that the pigment had been advertised for sale in Berlin in 1710 and on the words of the German chemist, Stahl, whose account of the discovery was printed in 1731. He wrote of it as occurring by chance twenty years previously '*ante quatuor forte lustra*' (one *lustrum* being a period of five years). Unfortunately, nineteenth-century and twentieth-century writers who quote the date 1704 fail to state the source on which their information is based, and, in the absence of new evidence, any enquiry into the date of the discovery must begin with an examination of the remainder of Stahl's account: he mentions two people, Diesbach the colour-maker who made the discovery and Dippel the alchemist who supplied some of the raw materials, and he states that both were resident in Berlin. Dippel did not live there permanently, however; an eighteenth-century biography contains the information that just before 1704 he was in Giessen and Darmstadt, and, after some time, he went to Berlin. From there he went to Frankfurt-am-Main and then moved on to Holland at the end of 1707.[98] This evidence suggests that the discovery of Prussian blue could have been made at any time between 1704 and 1707. A modern authority states that Dippel is known to have been practising chemistry in Berlin in 1705.[99]
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> Stahl's account of Prussian blue was written because the fortuitous nature of its discovery appealed to him. The chance manufacture of the pigment resulted indirectly from Dippel's production of an animal oil which was used medicinally; in the purification process the oil was distilled over some potash which was then treated as waste. Diesbach, who used to make Florence lake from cochineal, alum, English vitriol (ferrous sulphate) and a fixed alkali, ran short of alkali and asked Dippel for some of the potash which he saw had been thrown away. He was allowed to use it, and, after he had proceeded by his usual method, the lake appeared to be very pale. When he attempted to concentrate it, it turned purple and then deep blue. Diesbach returned to Dippel for an explanation and was told that the potash was tainted with animal matter. Stahl's account concludes with the comment that for some considerable time the pigment was made only in Berlin.[100]
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> Details of the manufacturing process were kept secret until 1724, when an account was sent from Germany to Woodward in England who allowed it to be published in *Philosophical Transactions*. The instructions were lengthy, but the method can be summarised as follows. To an alkali calcined with bullock's blood, dissolved and brought to boiling point, a solution of alum and ferrous sulphate was added while also boiling. During the effervescence which followed the mixture turned green, and, after it had been allowed to stand, it was strained. The residual greenish precipitate turned blue as soon as spirit of salt (hydrochloric acid) was poured on it. The pigment was then left to stand and was washed several times with pure water the next day, after which it was filtered and dried under gentle heat.[101] Woodward's communication was written in Latin and it doubtless became common knowledge quite quickly. By the 1730s manufacture of Prussian blue was widespread, as Shaw states in his *Chemical Lectures*, which contain manufacturing instructions in English: 'The Method of making this Prussian Blue in perfection, has been held and purchased as a very valuable Secret, both in England, Germany and elsewhere; but it is now got into several hands.'[102] No evidence has been found concerning the early manufacture of the pigment in England, nor has it been possible to verify statements concerning early manufacture which appear in nineteenth-century and twentieth-century works. For example, a number of modern writers give the impression that a colour-maker named Wilkinson was the first English manufacturer and that Wilkinson's

blue became a synonym for Prussian blue. The information can be traced back to Hurst writing in the late nineteenth century, but he merely states that Wilkinson developed the pigment.[103] Literary sources of the eighteenth century contain no evidence that the name Wilkinson's blue was ever used by artists. Colour names listed by Field in the nineteenth century are Berlin blue, Parisian blue and cyanide of iron. The origin of the first and last is obvious, and the second can be explained by the fact that a good quality blue was made in Paris. During the second half of the eighteenth century, considerable research was undertaken by French chemists in order to analyse the pigment and extend its use to the dyeing industry.[104]

Although Prussian blue was at one time used as a dye, it must be emphasised that it was originally advertised in 1710 as a pigment for artists' use. Following a summary of the limitations of other available blues, the notice in *Miscellanea Berolinensia* contained the announcement that the new blue which had been discovered a few years previously had been subjected to accurate tests. It was said to be absolutely durable in either oil or water colour and totally unaffected by nitric acid, fire or exposure to air. It could be ground to an impalpable powder and easily tempered with a knife, so it was suitable for miniature painters and oil painters alike; in addition, its softness meant that it would brush out well and mix easily with any other colour. Its versatility was such that, at full saturation, it was useful in painting shadows and, when thinned, it could be used as a lighter and brighter colour without any need for tinting with white. A great recommendation was its non-poisonous quality; it was said to be made from a kind of sugar so that it was edible, which meant that beginners could safely lick their brushes as they were liable to do. Finally, its price was attractive, being scarcely one-tenth that of ultramarine.[105]

Following the extravagant claims of the original manufacturer, one might expect the pigment to have been acclaimed immediately by artists, but such was not the case. Dossie states that anyone desiring permanent Prussian blue should prepare it himself instead of buying the pigment from a shop, because the commercial sort varied in strength and was unreliable. He further states that it can be used in all techniques except enamel, apparently overlooking fresco, a technique for which it is unsuitable. Quite possibly English painters were not particularly concerned with fresco, but Dayes mentions that Prussian blue is liable to be destroyed by alkali and that its colour is extracted by lime. Although no very early references to the uses of the oil colour in England have been found, it appears to have been well established by the middle of the eighteenth century, and painters in oils were well satisfied with the colour. Bardwell states that it 'is a very fine Blue and a kind working Colour', adding only the reservation that it should not be used alone in painting flesh. Nevertheless, he does not give is such high praise as ultramarine, and it was not until the second half of the eighteenth century that Prussian blue came to be the most important oil colour blue, as in Williams' *Mechanic of Oil Colours* where it is the only blue mentioned. The colour was reasonably priced, so amateurs used it as well as professionals, although not always without difficulty. It was probably no coincidence that a writer chose Prussian blue, a strongly staining colour, as an example in describing the difficulties to which self-taught amateurs were prone: ' . . . a bladder of Prussian blue bursts over one's arm, and paints one's fingers and clothes.'[106]

In water-colour painting Prussian blue was held in distrust for a considerable time. It appears somewhat as an afterthought in Smith's *Method of Painting in Water Colours*, where ultramarine is recommended for the best painting, otherwise smalt 'or Prussian-Blue will do as well'. In *The Art of Drawing*, 1731, the colour is said to be difficult to use because of its oily quality. Water colours were kept in shells ready for use, and it appears that whenever a wet pencil was applied to Prussian blue in the shell the colour went yellow where the water ran round the edge, suggesting therefore that the pigment was poorly manufactured at that time. Naturally, the presence of yellow was unwelcome because it accentuated the tendency towards green which is a natural characteristic of Prussian blue. By the end of the eighteenth century its manufacture must have improved, because Payne states that it is a good colour for miniature painting and that no other blue can equal its strength and transparency. Even so, there were many complaints that it did not flow freely and some writers, including Field, cast doubts on its permanence.

I hope that this, rather lengthy, quotation will clear things up a bit. [Over the years, I, myself an amateur given to pointing my brush (or *pencil* as it would have been called in the 18th Century), with my tongue and lips, must have ingested a monstrous amount of Prussian Blue without real hurt.]

My immediate feeling, not having access to the translation of Scheele's *Essays* by Thomas Beddoes (father of the author of *Death's Jest Book*, is that there is a general chemical mix-up which has led Robert M. Ryan astray, and that the sorting of matters requires further reference to Scheele's essays in German and in the modern translation by L. Dobbin, London, 1931, as well as the *Encyclopédie*, in French. It should be mentioned that the Swedish Scheele, investigating the properties of arsenic, did discover a green, later to be refined as Emerald Green, of copper arsenite. This discovery was made in 1775, but its composition is "made known because, as Scheele explained in 1777 in a letter to another scientist, he felt that potential users should be

warned of its highly poisonous nature, and, in addition, he wished to prevent anyone else claiming credit for the discovery," Harley, pp. 75-76. Ralph Mayer, whose *The Artist's Handbook*, Third Edition, The Viking Press, New York, 1970, is invaluable in many ways, is slightly untrustworthy on the history of pigments, during the period with which we are concerned, as are the authors of another necessary book, Rutherford J. Gettens & George L. Stout, *Painting Materials A Short Encyclopaedia*, Dover, New York, 1966, but both mention the more widespread use of copper aceto-arsenite, Emerald Green, probably first produced commercially in Schweinfurt in 1914, as a popular insecticide, Paris Green, which was in use, to my personal knowledge, into the 1940s, and it still retains an important place in von Oettingen, *op. cit.*, p. 242, as well as, still a pigment, in the newspapers recording the misfortunes of children eating the flaking paint in old houses.

One thing that is certain is that Prussian Blue has nothing whatever to do with the Zyklon-B used at Auschwitz or the cyanide-tablets formerly employed in certain American states. There is no possible excuse for giving a good color a bad name, Junkers, Berlin, Prussian, and condemning it with no trial or reason, as Robert M. Ryan has done in *Blake Newsletter*, 7 (Spring 1974), 87-89. [If I can digress for a moment, I would like to say that whenever I have a brilliant idea, I note it down and then spend a week or two in playing the Devil's Advocate and trying to tear it to pieces. If it stands up to my vicious attacks, I assume that, even if I am wrong, it is worth exposing to the blasts of my peers. A plenitude of references *is* too persuasive, and, even though the theory is false, can lead others astray.]

Now, having stated my tentative idea that the "poisonous blue" was merely the nitric acid with which Blake bit his copperplates, and having done my best, thanks to Dr. Harley, to show the innocence of Prussian Blue, I feel that I should list the various blues, with some note of their toxicity, which were available to William Blake. In doing this I draw not only upon Dr. Harley's book but also upon personal correspondence with her. I should remark here that Woad is kept for a third section of these notes. It had a more symbolical than actual pigmentary meaning by the end of the 18th Century.

[Todd's typescript leaves off here.]

YOUNG'S NIGHT THOUGHTS (LONDON: R. EDWARDS, 1797): A NEW UNILLUSTRATED STATE

By G. E. Bentley, Jr.

William Blake's five hundred thirty-seven watercolor drawings and forty-three folio engravings for the edition of Young's *Night Thoughts* which Richard Edwards published in 1797 were the largest commercial undertaking on which he ever engaged, but surprisingly little is known of it. No review has ever been discovered, only one periodical announcement is known,[1] and the publisher evidently went out of business within a year or so of its publication. Any light in this obscurity is welcome.

The work is generally known today in two illustrated States:

1) With the forty-three engravings uncolored--though in a few copies (such as that in Bodley) one or a few of the plates may have been accidentally omitted from the text-pages on which they were supposed to be printed--these uncolored copies are not uncommon;

2) With the engravings colored, at least some of them by Blake and his wife--some twenty-one copies of these are traced in *Blake Books* (1977), 642-646, 956-957.

A new unillustrated State of the work has recently been noticed:

3) Without any of the normally integral engravings.

Note that the engravings were normally printed on the same leaves as the text, surrounding the text. Consequently there is no question of the unillustrated copy having been separated from its illustrations during its subsequent history. The engravings were never present at all. And fairly clearly this was an original mode of issue, though no other copy in this unillustrated State has yet been traced.

The unillustrated copy may be described as follows:

BINDING: Bound in original pale green (card)boards, now much faded, covered with green paper in the same shade, with a leather lable on the spine reading "YOUNG'S / NIGHTS." There is no clear ownership mark or date in it, but a modern printed slip inserted reads "3530 / 994"[2]; the recto of the first flyleaf reads "[2.298 *del*] 2. 323" (presumably a shelf-mark); the top left and bottom right corners of the inner front board read in pencil "J / E" (?for James Edwards, Richard's brother); the bottom right corner of the back inner board has, upsidedown, "5/-" and, right side up, "9 / 70 / eoo" (presumably a code for the price at which a dealer bought it in September 1970). The first and last free flyleaves are watermarked 1794 / J WHATMAN and are conjugate with the front and back paste-downs, indicating that they were probably bound about the time the work was printed, since the binding uses the same paper for fly-leaves and paste-downs as is used in the text.