SPOT-ON OR NOT?
AN ANALYSIS OF SEURAT'S COLOUR THEORY

Roberta Lynne Marks-Donaldson

A Thesis Submitted for the Degree of MPhil
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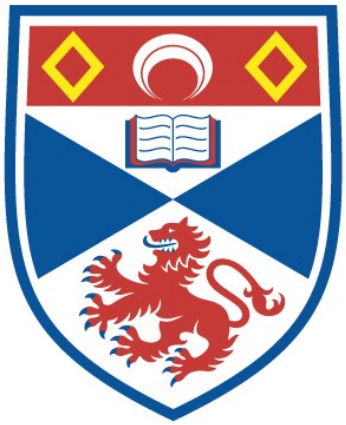

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I, Roberta Lynne Marks Donaldson, hereby certify that this thesis, which is approximately 95,000 words in length, has been written by me, that it is a record of work carried out by me and that it has not been submitted in this format for any previous application for a higher degree.

Date: 28 February 1997

Signature of Candidate: _____

I was admitted as a research student under Ordinance No. 12 in October 1985 and as a candidate for the degree of Ph.D. on a part-time basis in February 1986; the higher study for which this is a record was carried out in the University of St. Andrews between October 1985 and November 1994.

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The following two entries acknowledge work which was carried out on my behalf for my research and, without the results of these efforts, my work would have fallen far short of the target. The Art Institute of Chicago made colour transparencies of sections of La Grand Jatte, which I specified, in order that I could have ready visual references for my work. The five colour transparencies remain under the full copyright and ownership rights of the Art Institute and I thank them for the "visual" loan of the material. Peter L. Donhauser, the Coordinator for

Lectures and Tours at the Metropolitan Museum of Art in New York, sent me tape recordings of their Friday night lectures in the autumn of 1991 since I was unable to attend the lectures. These lectures were held in conjunction with the American half of the Seurat exhibition and were invaluable since they contained new material.

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Lastly, I must thank Bill who taught me the most precious lesson of all: Believe in yourself and live for the moment. It is all too easy to fret about things lost and fear things yet to come, to the point where one risks losing Now. Living in the

present and having a rock-solid belief in oneself will enable one to cope with anything and keep on fighting in the face of whatever life decides to deliver. I have always believed in Bill and, equally, his belief in me has never wavered; if anything, our belief has increased over the years. As a result of our soul-searching and mutual appreciation society, we've each learned to recognize new strengths in our own selves. It's easy, though somewhat scary, to profess love for that one special person but far more difficult to realize and accept that love and belief in oneself for oneself. Thanks to my very special Bill, I have discovered a love which has helped me to believe in my capabilities and this dissertation is a testimony to that newfound strength.

January 1992

Postscript:

Bill and I were married in the States on 19 September 1993 and his surprise gift to me upon our return to Scotland was a newly built and completely decorated study to use "to finish that blasted Ph.D.". At last, it is done! I dedicate this to my husband whose unfailing support has pulled me through the last stages of this exercise. Without his strong protestations of love, "You're the best thing in my life, next to my dog", I couldn't have done this. Thank you, Bill.

ABSTRACT

An analysis of mid- to late-nineteenth century scientific colour theories sets the stage for the introduction of the artistic style of French painter Georges Seurat. His traditional beaux-arts training, extraordinary skills as a draughtsman, and keen interest in the then existing science theories on colour combined in his person to create a new approach called Divisionism[1]. As Seurat's readings of scientific literature and his practical applications of the theories to his artistic style became refined, a new movement called Neo-Impressionism developed around him and through his example. Amidst both critical acclaim and scorn, Seurat proceeded with great determination from his novel drawing style to a refinement of his approach to colour. An untimely death ended the research of this singular artist just years before scientific findings were published which would have forced Seurat into a different approach.

An intensive look at Seurat's theories and key pieces is considered in terms of his objectives: A major point is whether what we now consider to be Seurat's theory was really what he had in mind; have our present perceptions distorted his original intentions? The materials Seurat had at hand, the chemical composition of the pigments and the effects of time, grime and light are discussed as to their impacts on achieving his goals.

An in-depth comparision of late twentieth-century colour research in perception via psychological, neurophysiological and artistic/emotional routes point out the strengths and weaknesses

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1 Also called Pointillisme, pointillism, and melange optique.

of Seurat's approach and explains what really happens in the visual process, as far as it is understood today. Scientific colour theories and artistic colour approaches can form a redoubtable partnership but could they ever have become one to exist in the optical mixture we believe Seurat had so wished to elicit?

CHAPTER ONE

INTRODUCTION

Imagine yourself riding upon a soap bubble. You are small enough so that the bubble can carry you up in the air. The surface tension is strong enough to keep you on the surface without puncturing it yet, due to the slippery characteristic of the soap, you cannot stay in one place upon the surface. You decide to join the iridescent swirls in their lazy game of tag, purple catches blue which joins green before touching orange. Over and over, the lazy, rhythmical pattern grows, builds, changes and dissolves before continuing its hypnotic flow in yet another direction. You are so mesmerized by the colour show that you momentarily forget to focus your attention elsewhere until your skin suddenly develops a green cast. A mild curiosity makes you look up and you realize that the green is being reflected onto you from a tall tree. As you and your bubble continue to drift lazily upwards, the green tone intensifies or lessens depending upon the density of leaves and you find sport in trying to predict where the next dapple of sunlight will strike. All too soon, you are above the treetops, so you eagerly scan the panorama below. A rainbow appears off to your right and the wind, somehow sensing your desire, carries you toward it. Your amazement knows no bounds when the lovely arc of colours becomes a circle as you pass directly overhead it. You ponder this wonderful feat as the rainbow folds itself back into its more normal arc and, as the sun sets slowly behind you, you admire the

increasing intensity of the mauves, violets, and blues. Your magic bubble carries you into the darkness of the night and awaits in the shelter of some star for another day to begin. Your flight of fancy is over.

Wouldn't it be wonderful if we could perceive our world from such a new and different perspective and feel anew the wonder and awe toward all that nature proffers? What a way to sustain an enthusiasm about life! There would be little need for artificial enhancers and stimulants if bubble rides over the treetops were available. And yet, upon further examination, all that the above scenario represents is a closer look at some facets of the behaviour of light and colour. A study in depth of the world of light and colour might offer a similar and enlightening (no pun intended!) release from the mundane.

A person does not need a formal training in the scientific properties of light to experience its effects, nor does he need the soul of an artist to anticipate the potential of colour. The above scenario illustrates, to name but a few phenomena; iridescence, reflected light, angle of incident light, refraction of light, interference and what is known as the Purkinje effect to the scientists. Most artists, however, would be more concerned with the warm or cool colours, strong or weak colours, and the degree of light and shadow. It seems, therefore, that some background in either science or art would most certainly lead to a heightened awareness of light and colour.

One might further suppose that a knowledge of some of the scientific aspects of light could best be put to use by an artist

who possessed a gentle and sensitive soul if, for the sake of this argument, we presume all artists to possess gentle and sensitive souls. Such a combination would take the best offerings of the scientific world and place them in the capable hands of the artist; therefore, that knowledge of light could be employed in the best possible way to depict colour.

The year 1991 marked the 100 year anniversary of Georges Seurat's death. He was a painter who died suddenly at the young age of 31; a painter who burst upon the art scene at the tender age of 24 with a new style which received both praise and scorn but which most certainly was not ignored; a painter whose intellectual and fanatical approach to his work attracted a following who clamoured for guidance but who got little more than some sketchy pages of discourse; and a painter who struggled to control his subjective input to give objective analysis free rein. Seurat was a painter, and a man, who not only lived with a mistress and had a family by her, but who managed to keep that side of his life a secret from his friends and parents until just days before his death.

Who was this man? More importantly, why did this man who lived such a short and quiet life have such a lasting impact upon the artistic environment of his time? Why is his style and theory still being discussed one hundred years after his death?

My dissertation will begin with a brief examination of the areas of convergence between the centrality of science in artistic innovation and the role of artistic creativity in scientific thinking with a specific emphasis on the area of

colour in painting. Artists working in a naturalistic tradition need to know how best to reproduce a three-dimensional world on a two-dimensional surface and the findings of science can supplement their talents. Therefore, the rules of science can guide the artist while the artist can encourage the scientist to push his definitions and boundaries to their limits. Seurat was one of the artists of the second half of the nineteenth century to make a conscious and concerted effort to employ the new and rapidly expanding scientific findings in his art.

Seurat's career was short-lived yet, in the small span of only a decade, he set a new trend in artistic styles as he sought to refine his own approach to art. His early masterpieces, and La Grande Jatte in particular, show a high degree of tension as he struggled to align any subjective introspection with the objective description as set by science's dictates. My detailed examination of La Grande Jatte, with a follow-up look at his later pieces, will help to reveal whether science and art were neatly joined or whether the percept became totally estranged from the concept.

Seurat chose to apply the logic of science and its empirical findings in his art. Yet, by doing this, he set himself up with the almost insurmountable problem of meshing happily the two diverse fields. His use of balayé and pointillist brushstrokes to represent the fleeting and evanvescent qualities of natural light only served to create a very unnatural, divided and "splotchy" view of reality. However, and this is the key to appreciating Seurat's efforts, the divided colours and splotchy

appearances of his subjects were meant to recombine, to a certain extent, in the eye with a subsequently increased luminosity; those colours which did not fuse or mix in the eye were meant to produce a "flicker" which would also increase the overall luminosity.

Scholars from both science and art have reviewed the paintings born from what they believed to be Seurat's basic presumption: that more luminous colours would result from an optical mixture of juxtaposed pure colours. However, there is little agreement between scholars of science and art concerning the success of his approach and his theory in general. Questions have been raised concerning: 1) his ability to remain true to his "scientific" theory without subjective and artistic "contamination"; 2) the validity of the theories upon which he based his work; 3) Seurat's possible misinterpretation of some of the theories; 4) whether he relied upon the viewer to play a "visual game" in order to receive the best results, with viewing distance, viewing angle, duration of viewing and lighting effects becoming variable factors in the game; 5) whether his "studies" were in fact just that and not produced as more readily marketable mini-masterpieces; 6) whether unreliable materials ruined his attempts to prove his theory; 7) whether, more fundamentally, his theory could have even succeeded given the human physiological and neurological set-up for colour perception as identified by new research during the past few years; and 8) whether, in the final analysis, he was trying to be "scientific" at all. Most of these questions have been put forth by scholars

in the past and some have been triggered from my own initial research, but none, to my mind, has been satisfactorily answered.

In order to answer these questions, a basically chronological approach will be taken to introduce each of the factors to be examined and to consider why they became so important to Seurat. Additionally, I will try not to "read into" what stands before me on the canvas, which is one of the greatest hazards of any historical approach. Seurat's remaining written explanations of his process and his theory are sparse and the majority of his objectives have been construed from critical reviews and comments of friends at the time. There is a real danger in finding intentions and meanings where an artist never wished them to be. Conversely, a viewer may pick up on something the artist was not aware of creating; so, another approach might be "..if they are present [the meanings], the artist did intend them, whether or not he was wholly conscious of the fact."[1] Nevertheless, I will try to view Seurat's works as objectively as possible whilst keeping in mind the changes my 20th century eyes will effect upon the situation.

If Seurat so consciously sought out the world of science and its findings, it would be ludicrous to try to interpret his work without examining the scientific factors he was thought to have used. Conversely, since he was trained and labelled as an "artist" it would be folly to ignore the effects this would have upon his application of science. A critique of the existing literature of Seurat, complemented by the review of the late 19th

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[1] Daniel C. Rich, Seurat and the Evolution of *La Grande Jatte*, New York, 1935, p. 6. My brackets.

C. colour theories and how they have withstood the test of time, may provide for a richer interpretation of Seurat's success as an artist "dabbling" in the world of science.

The chronological analysis of Seurat's works, from his earlier masterpieces to his later works, will reveal whether he worked through any of his technical and theoretical problems as time progressed. Special attention will be given to the materials which Seurat could have used, because another hazard of an historical overview in art is to pass judgement on something without fully considering the limitations of the materials at the time in question. His paints are a prime example of this: although the pigments of the mid- to late-nineteenth century were being produced to a higher quality generally, the manufacturers' rush to meet the increasing demand from the consumer market caused some products to enter the market which were not reliable or of a proven quality. Unfortunately, it only takes one bad ingredient to affect, if not ruin, the permanence of the end product.

A look at modern research into colour perception from the areas of psychology, neurobiology and the basic physiology of the human visual system will extend the nascent findings to which Seurat had access. This may also offer new insight about the possibility of his theory being correct by helping to define the visual process as far as science can reach today. This will be done while keeping in mind that bringing contemporary findings to bear upon historical material in itself is a precarious balancing act. The new findings will help to define within which parameters

his works are effective as well showing what, if anything, went wrong from his theoretical stage to his practical application of the theory.

The research of this project is based primarily upon firsthand study of many of Seurat's drawings and paintings. This has entailed travel throughout Britain, principally to Edinburgh and London to view the Seurats held in the collections of the National Galleries, the Courtauld Institute and the Tate Gallery. A couple of trips overseas to the Art Institute of Chicago to see La Grande Jatte were made as well as a trip to each of the locations of the Seurat retrospectives held first in Paris in April 1991 and then in New York in December 1991. It was decided that it was preferable to view Seurat's drawings, études and paintings as many times as possible in order to refresh my memory of them; no matter how good a reproduction seemed to be, the colour was never true to the original--a fact which must always be kept in mind when discussing colour and looking at photographic reproductions. Furthermore, only those works which I was able to view in person, or of which I had quite reliable colour reproductions, will be discussed in any detail when addressing the colour aspects. I was not able to see The Poseuses in the Barnes Collection, for example, and so I will only discuss the composition and the style; any comments on the colour will be from other researchers' first-hand viewing experiences and will, by necessity, be kept to a minimum.[2]

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[2] Items from the Barnes collection are now on tour around the world. Included in the exhibition is Poseuses though, at the time of this writing, I have not yet been able to see it firsthand.

One need merely to look through the accompanying illustration volume to see the differences between the colour photographs and the colour photocopies; the colour photocopies were reproduced from the photographs. The colour photocopies "average out" colours through a laser process which removes them even further from the accuracy of the coloured originals. Films, too, can distort colour; Kodachrome tends to produce a nice warm overall blend while Fuji photos look sharper by comparison because of their greater emphasis on greens and blues.

Furthermore, looking at works in person is beneficial because of the size factor. One can read that a painting measures 207 x 308 cm for example, but not fully appreciate the enormous scale of the canvas until standing in front of the overpowering scene. Part of Seurat's intention, I believe, is to have the viewer walk back and forth in front of one the larger canvasses and slowly read the picture; this vital aspect vanishes entirely if the paintings are viewed solely in photographic reproductions.

I was unable to see much of the original documentation from Seurat, his friends, or those in his generation and had to rely upon snippets which have been quoted directly in other sources or translations of the originals and discussions and analysis from other scholars. However, these writings have been so extensively read and discussed that it is legitimate to regard them as being reliable. I did, however, obtain Henry's Rapporteur Esthétique (1888) and Cercle Chromatique (1889)[3] and have seen writings of

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[3] Charles Henry, Rapporteur Esthétique (1888) and Cercle Chromatique (1889) both Paris.

Blanc, Chevreul Sutter, Helmholtz, Hering, Goethe and Sutter to which Seurat had access. I was only able to study the German writers through their English translations and, for the French publications, I tried to see both the original and English versions.

The science documentation from this century followed as a result of my first degree in Psychology and my interest in visual perception with a strong emphasis on colour perception. I was able to locate and establish written contact with scientists in Britain, America and Canada who are working at the forefront of visual research. The reports of these findings and their implications in my Seurat research are discussed in Chapters 6 and 7

THE ART OF SEEING

What does it mean to say that someone is "creative" and that another person is an "artist"? In today's terms, to "create" means to bring into existence something by one's actions, yet the word "creativity" suggests a further dimension. The concise Oxford English Dictionary stresses the imaginative side of this inventive act; "showing imagination as well as routine skill"[1]. The implication is that anyone with training and skills can create but it is only those with the ability to infuse this act with their imagination and put something personal into the process, those who are truly creative and who can leave the category of trained and skilled craftspeople behind, who may become artists. Again, the OED definition for artist is "one who makes his craft a fine art"[2].

As Gombrich points out, just long and intense "looking" won't teach an artist his trade, he needs skills and techniques as well.[3] Seurat's friends "...Félix Fénéon and Emile Verhaeran assiduously pointed out that his scientific approach did not contradict the essence of art, for the most perfect knowledge of the laws of optics had never produced an artist."[4] Thus, training can further an artist's skills and produce "better" artwork, but only after the prerequisite of "being" an artist has been fulfilled.

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1 The Concise Oxford Dictionary of Current English, 7th edition, London, 1982, p.223.
2 Ibid., p. 49.
3 E. H. Gombrich, Art and Illusion: A study in the psychology of pictorial representation, London, 1960, p. 11.
4 John Rewald, Seurat: A biography, London, 1990, p. 12.

Therefore, if an artist appreciates how he sees by understanding what is involved in the visual process from scientific research, for example, he should be able to use that formal knowledge to take full advantage of the visual system in his painting. Knowing what the visual system requires to make it function at an optimum capacity helps to define what should be included in the visual input and what should be rejected. Thus, acquiring skills and techniques in the creative process, as well as knowing what is involved in the visual process, should produce the best representational art, i.e., the most visually effective art in terms of the evoking of a naturalistic illusion. This is because such an approach will provide the best possible provisions on both the giving end (what is required representationally to "trigger" properly the visual system) and the receiving end (what the visual system needs to see).

With today's research advances into the visual system, science and art maintain this mutual dependency--though their intertwined strands may appear tenuous, they are there. The making of a picture must conform to certain conditions--both intuitive/artistic and functional/scientific ones.[5] This means that there is no pure expression of a scientific model because of the artistic input, but also that there cannot be the creation of something representational without implicit or explicit science.

If we agree that art and science together enable an artist to produce the most visually effective painting possible, then we must consider the next step: the reception this art elicits from the viewing public. Tastes change from the preferring of

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[5] It must be noted that both the terms "science" and "art" have been subject to continuous re-definition with the passage of time and that the definitions being used here are modern and post-Romantic in nature.

classical and idealized forms to stylized figures then to photographically representative scenes, and so on. If the public is not ready for a change, or a different "taste", then, what in retrospect might have been the most visually effective art, will be scorned outright and condemned without a chance at the time of its creation. The beginning of the nineteenth century was a time of such change but, rather than have the art change to suit the public, the public had to be re-educated to see the art properly; at this time, the question of seeing was focussed on the audience rather than the artist.[6]

The first incredulous public reactions to Impressionistic art forced the Impressionists seriously to question whether their use of psychology of perception had helped them in an accurate portrayal of the world; especially since what the public saw in the Impressionist paintings was far from what they would judge to be accurate. Not for the first time, this interplay between the artist and the viewer seemed too strong to be ignored; the mind-set in the public and the relationships between "the expected and the experience"[7] were too strong to break. New images had been created but the beholders were unable to read them.

How then, does an artist who desires to use his knowledge about vision to enhance his art overcome such problems with a visually conditioned audience? The Impressionists had tried to paint the world as they saw it on their canvas, at a specific moment in time, and hoped, with the aid of modern science, to illustrate the visual process with "scientific accuracy"[8].

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[6] Gombrich, Op.cit., p. 14.

[7] Gombrich, Op.cit., p. 60

[8] Gombrich, Op.cit., p. 394. The phrase "scientific accuracy" really is an oxymoron in this application. The Impressionists used the science of colour and how it changed in different lighting conditions to help them capture a

However, the Impressionists used the science of colour and how it changed in different lighting conditions to help them capture just one moment in time; thus, at another and different moment, the same science would not apply since it did not further their process at that specific time. Therefore, the Impressionists' use of "science" was scientific only in the loosest interpretation of the word since it was limited to its specific applications. If we accept that this application of "science" to Impressionist's art was arguable regarding its efficacy on a broader basis, can an artist, in his lifetime, ever resolve the problem of presenting a new approach to a visually conditioned audience ?

It could be said that the vision of the successful artist involves insight, hindsight, and foresight. A successful artist must have insight into what the public and potential customer demands, hindsight to learn from his mistakes and the foresight to anticipate or, perhaps, precipitate any changes in taste. Accurate perception in all senses of the word "sight" seems the prerequisite to achieving success.

Seurat was an artist who has gained more recognition and general appreciation only with the long passage of time. It is true that he had the foresight to take his stand in advance of the swing in public tastes and to take advantage of them yet he barely lived long enough to apply his hindsight to any faulty judgements he may have made. Sadly, his insight into "the consumer market" was almost entirely overridden by his desire to express his ideas in a style he thought best and it was, perhaps,

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moment; at another and different moment, the same science would not apply since didn't further their process at that specific time. Therefore, their use of "science" was scientific only in the loosest interpretation of the word; it was not "accurate" nor was it strictly and carefully applied.

this uncompromising drive which revealed a defect in his vision. If he had been more willing to introduce his style at a pace to suit his audience, perhaps he could have achieved success as an artist during his lifetime rather than receiving it belatedly, and posthumously. Then again, suggesting creative compromise to an artist can be tantamount to murder; stemming an individual's creative flow destroys exactly what the audience is seeking--even if they fail to be adept enough to perceive it.

Even so, Seurat "arrived" on the art scene, that is, the world became aware of work which he had been quietly and persistently developing at a time when something new was being sought and, therefore, at a time when different styles and approaches would be more readily accepted. Although Seurat was one of those fortunate artists who did not need to rely solely upon income from his profession to survive; nevertheless, he would probably have appreciated some form of approval and acceptance whether from sales of his works or praise of his style. In reality, he received little recognition by either measure: the first painting he sold was Le Bec Du Hoc in 1887.[9] His style was more often criticized and attacked rather than praised.

The impact of Seurat's style will be discussed in detail later as will his subject matter and the great speculation it then provoked. Yet, one hundred years later, the supposition on Seurat's subjects persists and it is this which will be addressed first. From a safe distance and with the benefits of hindsight, it is quite human to make pronouncements about what someone intended to show in a painting or what some painting "reveals"

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[9] John Rewald, Seurat: A biography, London, 1990, p. 215.

about the era in which it was created. With this caveat in mind, my study will begin with the social, artistic and scientific "meaning" of Seurat's works as reflected in the past 90 years of critical commentary and historical literature on Seurat.

Literature Review

One of Herbert's opening sentiments in the impressive Georges Seurat: 1859-1891 volume is:

> "The present exhibition gives us the opportunity to reexamine Seurat's art and theories and their central role in the short-lived Neo-Impressionist movemment. Although artists and critics alike regarded Seurat as the inventor and leading artist of Neo-Impressionism, the ebullient Signac was the more effective propagandist for the movement, and Dubois-Pillet was the group's best organizer within the Indépendents."[1]

With this statement, Herbert sets up the goal of the exhibition and the publication which is to examine Seurat's role in the Neo-Impressionist movement by debunking three persistent views of Seurat. First, that Seurat was the chief proponent of a "scientific" colour theory; second, that his works are "brilliant visual distillations of psychological and social meanings", and; third, that since Seurat's paintings do not provide the visual effect of light, his theory has failed and, therefore, he has failed as an artist applying science to his craft.[2] Thus, Herbert sets out to re-define Seurat's science and his approach to his art.

A re-definition of Seurat's "scientific" theory involves several factors. No one alive today can tell us firsthand what it was like to live in Paris when Seurat's art first began to receive public recognition. We can only read and interpret comments from that time based upon our stance in the present. Since so much of the interpretation of Seurat's work involves

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[1] Herbert, Georges Seurat: 1859-1891, p. 3. Since Herbert was one of the main contributors to this book, his name will be used whenever the book is mentioned unless a specific quote from someone else is cited.
[2] Herbert, Georges Seurat: 1859-1891, p. 4.

some knowledge of what "science" is, of how he applied his science and of how his artistic training affected his "scientific" application, the definitions of such terms as "experiment", "scientific control" and "art", must be understood and agreed upon so that they may serve as guidelines for any discussion of Seurat.[3]

Additionally, when asking, "Is Seurat's work scientific?", a definition must be stated, implicitly or explicitly, for what constitutes being scientific and what does not. Our definition for "experiment" supplies a rather rigid 20th-century definition for something which falls within the realm of "Science" and there will be limits as to how far this definition can be taken back into time while still remaining applicable; having such a cleanly enumerated set of criteria, within very specific outlines, certainly will become less applicable the further it is taken back into history, even if we only go back into time one hundred years. Thus, if we cannot state a more elastic definition of "science" and its key components, we need to remember that "science" is subject to re-definition each time it changes within history.

In his book The Science of Art, Martin Kemp addressed these issues; in trying to define what constitutes a scientific investigation he leans towards a qualitative notion of science which is annexed by artists rather than a quantitative notion with all the associated empirical involvement.[4] Although he discusses this issue in far greater depth, and over a far longer

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[3] The specific definitions of these terms for the purposes of this paper are found in the glossary.

[4] Martin J. Kemp, The Science of Art: Optical themes in western art from Brunelleschi to Seurat, New Haven and London, 1990.

stretch of time, the point is clear that one must be aware of, and perhaps be willing to create, a more fluid definition of science as it is applied to art throughout the ages.

"Science", as defined under Helmholtzian approaches, if we consider Helmholtz to be representative of 19th century approaches, is purely empirical; there is no absolute a priori theory and all is based upon direct observation and experimentation. Therefore, an approach based upon some sort of systematic knowledge, or some set of empirically derived rules, will be "scientific". On this basis alone, one can say Seurat was scientific because of his systematic approach to his art; even though this does not necessarily mean his approach was empirical.

The modern philosophy of science, however, has diluted the empiricist approach. The way in which science constructs its ideas and the way in which it is strongly influenced within the social structures of the time, have weakened the absolutely pure definition of "science". Thus, Seurat may be classified either as a scientific artist using the laws of physics to aid his art or he may be regarded as a misguided alchemist trying in vain to apply the pseudo-science of his day; there is some contamination regarding the definition of science in addition to the factor of how correctly he applied the "science" to his art.

Seurat's academic upbringing dictated, and believed in, a systematic body of doctrine which the artists used to articulate their practice; so, again, by the reasoning above, this systematic doctrine of the academic tradition has a broadly scientific orientation. If we continue this line of thinking further and apply it to divisionism with its very systematic

application, it, too, will fall under the academic tradition. Therefore, Seurat's carefully balanced knowledge of the existing empirical investigations of the day, his rigid theory and the actual pictorial requirements, are all melded together in the academic tradition which, by its very nature, has a scientific orientation.

Although the two factors of science and art seem to be running along the same track in Seurat's case, the split begins when one realizes that the academic tradition appears to involve a synthetic factor while purer science does not. Science involves the process of analysis from appearances while the academic process of art requires the artists to remake the world from a process of synthesis since they have to pull numerous factors together. How pigments work, how the composition works, how light works, how illusions work, and how colours work, all have to be synthesized in order to create art. Phrases of "freedom of expression" and "imitative or imaginative skill" help to define art while terms such as "control", "definitions" and "regulations" concern science and show how us these two areas separate further.

Artists may have a tendency to be skeptical of scientists simply because of their stress on controlling everything except the independent variable. Scientists, on the other hand, may admire the results of an artist's skill while voicing disapproval over the artist's loosely controlled approach. Yet, it has already been mentioned how each side can benefit from some approaches of the other and how art and science are inextricably bound together when trying to reproduce three dimensions on a two-dimensional surface. Given this mutual dependency, we must

keep in mind that regardless of how much science an artist chooses to apply to his art, he will still apply it like an artist; artists react to all of the pictorial considerations and the needs of the composition simultaneously, they do not behave like scientists manipulating just one factor at a time.

In this literature review it must also be kept in mind the mutual dependency which existed for Seurat between science and his art. Neither one can be excised for examination and critique without destroying the blend he had achieved. It would be like pulling a long and colourful thread out of a very complex tapestry and then trying to appreciate what remained, there would be gaps in places and snarls in others while the overall effect would be that everything was slightly "off" because the weave had been destroyed. Thus, one must be aware of all interpretations of Seurat's works; neither the scientific nor the artistic viewpoints can be ignored without skewing the impression created from the remaining factors.

I believe it is necessary to mention that the traditional approach of art history, with its heavy emphasis upon theory and the rational approach is shortsighted because it often leaves a very important factor unexamined: the creative act itself. It seems lopsided to judge artwork, or evaluate an artist's life, without some knowledge of the techniques and methods involved in its creation. This point is quite important and will be addressed later on when the writings of the 20th century scientists and critics are discussed. Some writers might dismiss Seurat's work as impossible and out-of-hand, without even considering the creative process or what was being attempted.

The writings to which Seurat could have had access have been cited and indicated so many times that a brief recapitulation will suffice here. Chevreul provided vital colour information for the Impressionists and the Post-Impressionists in 1839. His historical development of colour in theory and applications to paintings were of extensive value to artists.[5] In 1867, Blanc provided some technical tips which Seurat considered and also gave indications of Seurat's having studied other artists for their techniques on colour mixing.[6] Rood greatly influenced the Neo-Impressionists in 1877 through his practical approach, which was backed up by his scientific research, and Seurat is known to have copied Rood's colour contrast diagram as a guide.[7] George Field, an English paint chemist, helped to modernize paint manufacture. His interests in painting embraced notions that three basic lines (curved, angular and straight) combined to form all other figures, producing a sort of cosmic harmony, foreshadowed approaches defined by Henry, for example, which Seurat was to adopt in later years.[8] These and other sources provided productive and practical information upon which Seurat drew.

The 1810 research of Goethe was more concerned with the phenomenological aspects of colour and their psychological impact. Basically, his research was speculative and unsupported

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[5] Chevreul, The principles of harmony and contrast of colours, London, 1854, originally Paris 1839.

[6] Charles Blanc, The grammar of painting & engraving, Chicago, 1879. Blanc mentions that Seurat studied Murillo's La Naissance de la Vierge, Delacroix's Soéne du massacre de Scio and Monet's La Chasse for their pointillistic approaches.

[7] Ogden Rood, Modern chromatics: Students' text-book of color with applications to art and industry, New York, 1973, trans. into French 1881.

[8] George Field, "Aesthetics or the Analogy of the Sensible Sciences Indicated (of Colours and Sounds)", The Pamphleteer, 1820, p. 206-209.

by scientific research, at least as defined by Helmholtz.[9] Herbert says it best about Goethe: "...in which extraordinary inventiveness and brilliant powers of observation are placed at the service of the fundamental error: the belief that color originates in black and white."[10]

Both the critics and defenders of Seurat's style published comments when Seurat was alive as well as posthumously. Two of the most outspoken were Signac, a friend and fellow-painter who supported Seurat before the stress and strains from the outside world broke their camaraderie, and Fénéon, the self-professed defender of the new style who wrote only with Seurat's technical approval. Thus, when Signac states: "...For the complementary colors, which are allies and enhance each other when juxtaposed, are enemies, and destroy each other if mixed, even optically. A red and green surface, if juxtaposed, enliven each other, but red dots mingled with green dots make an aggregation which is grey and colorless."[11]; he is correct in describing a basic tenet of Seurat's theory. Although Signac may have intended to point out a fault in Seurat's theory, in reality he manages to identify that only an incorrect application of the theory would lead the artist into difficulty. The process itself was not problematic.

Even though Fénéon wrote with Seurat's approval most of the time and, indeed, served as the mouthpiece for Seurat, Fénéon

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[9] J. Goethe, Theory of colours, Cambridge, Massachusettes, 1870, original 1810. Even though Goethe made extensive and systematic observations, they remained just that; observations. He did not make use of controlled and replicable scientific investigation; hence, the lack of scientific research.

[10] Robert Herbert, "A Color Bibliography", Yale University Library Gazette, 1974, p. 6. This bibliography by Herbert gives quick reviews of anything in the Faber Birren Colour Collection and provides a thorough starting reference point. The bibliography was increased by another 220 entries in 1978 in "A Color Bibliography, II: Additions to the Faber Birren Collection on Color", p. 127-165.

[11] Signac, De Delacroix au Néo Impressionisme, ed. F. Cachin, 1964, 108.

has, at times, been under attack for his summaries of Seurat's work. To this day, statements such as the following remind us that some take issue regarding Fénéon's reliability: "...Fénéon's ill-informed resumé of some of the principles he [Seurat] found in Rood's textbook..."[12] However, rather than being a misrepresentation by Fénéon of Seurat's thoughts and applications of Rood, what had occurred was a basic breakdown of communication from Seurat to his supporters after Seurat began to suspect he was being misrepresented. In fact, as we will see later, some of the clearest writing concerning Seurat's methods came from Fénéon.

In 1921, Robert Rey provided a valuable discussion of the sources for Seurat's theory; he also included, for the first time, a copy of Seurat's much quoted and referenced letter to Maurice Beaubourg, which outlined Seurat's theory, before explaining the implications of the statements in greater detail.[13] Rey's interpretation of this letter and the import which it contained regarding Seurat's theory, remained virtually unquestioned for seventy years until the efforts of the researchers compiling the 1991 Seurat exhibition revealed a very different insight regarding this key document. The startling aspect about this letter to Beaubourg was that it was never sent to the man; although several versions were penned, none were ever posted.[14] This should serve as a warning by showing how complacent acceptance of one "fact" can skew subsequent interpretations.

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[12] John Gage, "The Technique of Seurat: A Reappraisal", Art Bulletin, Vol. 69, No. 3, September 1987, 453.
[13] Robert Rey, La Renaissance du sentiment classique dans la peinture francaise `a la fin du XIX si`ecle, Paris, 1921. p. 133.
[14] Herbert, Georges Seurat: 1859-1891, Appendix E, p. 381-383.

In the 1920s the main attitude of social literature about Seurat was that he had triumphed over nature, he had controlled her and mastered her. A parallel was cited between Seurat and modern technology and he was dubbed by some to be the father of Modernism.[15] During this decade, Seurat was analyzed for his use of form and colour theory. He was also given credit for using the golden section while the social aspects and implications of his work were all but ignored. Yet, Seurat's supposed reliance upon the Golden Section has only recently been shown to be false. The debunking of this golden section notion took over 70 years; not because scholars did not care but, perhaps, because once a statement is made it becomes so generally accepted as correct that only a newcomer to the field of academics might question such a "gospel" of scholarly research.[16]

During the 1930s, there was a shift in the Seurat literature. Meyer Schapiro was the first to emphasize broader views of Seurat's works by showing how the formal language and arrangement of the picture were inseparable from its social references.[17] Rich declared that although Seurat chose from Nature he still primarily was interested in the formal relationships; this was a basic affirmation of Signac's viewpoint but one which is slowly fading away now.[18] The relationship

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[15] Robert Herbert, "Craft versus Science" paper, Seurat: 1859-1891 Symposium, Metropolitan Museum of Art, New York, 7 December 1991.

[16] The idea of Seurat's having made use of the goldern section was conclusively disproven by Herz-Fischler (1983) and Neveux (1990), See Herbert, op.cit., p. 8. Full credit has been given for their work and Robert Herbert even acknowledged his mistake since years earlier he had been convinced that the golden section had been used by Seurat. A perfect example of "if you want to believe in something hard enough, you can find substantial support for your beliefs everywhere"--even where the support fails to exist!

[17] Meyer Shapiro, "New Light on Seurat", Art News, 57, 2, (Apr 1958), p. 44.

[18] Daniel Rich, Seurat and the Evolution of "La Grande Jatte", New York, 1969.

between Seurat's work and similar developments in the Symbolist writers was also discussed at this time. Since Seurat's paintings were now being studied in the context of the social history of the time, the general regard for his work became more poetic and humanistic than it had been previously.

In 1944, J. Carson Webster questioned the scientific emphasis of Seurat's theory and tried to replicate with newer materials some of Seurat's techniques to see if the desired effects of greater luminosity via optical mixing were, indeed, obtainable.[19] He could find no advantages in optical mixing from the pointillistic technique over the more traditional palette mixture of colours. Although Webster failed in his attempts to replicate the effects which Seurat had sought, and basically, he debunked Seurat's use of colour primaries, later writers began to question whether Webster had gone far enough.[20] The focus of Webster's study had been Seurat's application of divisionism and its supposed benefits over other methods; the fact that the technique may have been Seurat's means to another and different effect was not considered.

In 1958, Dorra and Rewald published a descriptive catalogue of Seurat's works and this approach was furthered by the publication of C. de Hauke's comprehensive catalogue raisonné in 1962; this was also the year for another publication by Herbert which dealt with a study and critique of Seurat's drawings.[21] With the publication of these three works, the majority of

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[19] J. Carson Webster, "The Technique of Impressionism: A reappraisal", College Art Journal, November 1944, p. 3-22.

[20] Herbert, 1968 and 1970.

[21] Dorra et Rewald, Seurat: L'oeuvre peint, biographie et catalogue critique, Paris, 1959; C. M. de Hauke, Seurat et son oeuvre, 2 vols., Paris, 1961; and Herbert, R. Seurat's drawiings, New York, 1962.

Seurat's works were now catalogued for reference and C. de Hauke's classification system remains in use to this day.

Homer's work in 1964 was the first major effort at tackling the issue of science in Seurat's art and it remained basically unchallenged for decades.[22] It is a subscriptive account and, perhaps, the most comprehensive explanation to date of what Seurat was trying to do with his theory. Although it is not a comprehensive monograph on Seurat, it remains one of the most original and interesting books on Seurat. Homer carefully and painstakingly addresses issues in Seurat's theory, from his earliest works to the changes his later pieces exhibited; goals Seurat had hoped to obtain, and how his works were received at the time, and; sources to which Seurat turned for inspiration. Homer's research was done from existing documents by Seurat or from those regarding Seurat. Homer also had the great good fortune to be able to consult with colleagues such as Dorra, Rewald, Rich, and Schapiro in addition to being able to consult personally with Mme. Ginette Signac, Paul Signac's daughter, and César de Hauke, a friend of Fénéon; these contacts revealed new insights and unpublished documents on Seurat.[23] The basic conclusion Homer draws is Seurat was successful with his optical mixing approach to colour and it was only Seurat's early death which prevented even more interesting and masterful works being produced.

Conversely, Weale's research of 1972 and his master's dissertation of 1974 disallow for the possibility of Seurat's

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22 William Innes Homer, Seurat and the Science of Art, Cambridge, 1964.
23 Homer, op.cit., 1964, p. ix.

pointillist technique ever succeeding.[24] Weale applied a scientific interpretation to several well-known artists' works and their approaches to their work; Seurat was one artist whom he studied. Weale is now a leading authority on colour vision and his strong science background supports his judgements from a physiological point of view; basically, he states that pointillism could not work in a purely scientific practice. Since Weale was unable to measure any physical advantage in pointillist techniques versus more "normal" painterly styles, he states that there is no measurable physiological bonus. However, I feel he fails to appreciate what is happening artistically on the canvas of Seurat's works as he disallows for any psychological or emotional benefits from different colour mixing techniques. Still, his comments and interpretations of Seurat's approach invite researchers to re-assess their judgements of pointillism.

In 1987 Lee published "Seurat and Science" whose introductory line imply a new evaluation of Seurat's theory has taken place.[25] Although Lee seems to indicate that his piece will examine questions about Seurat's use of science, he focusses instead upon the fact that Seurat got it wrong; that his theory and techniques were based upon a misinterpretation of the science to which he turned; in short, that La Grande Jatte can never work on optical terms. Lee does not seem interested in discussing under what parameters La Grande Jatte did work, nor does he seem to care that Seurat was able to reach such an advanced stage in

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[24] Robert Weale, "The tragedy of pointillism", Palette, 1972, p. 16-23. He supplements his statements with photographs of slides projected at different magnifications to illustrate the failure of pointillism. See also Robert Weale, "Theories of light and colour in relation to the history of painting", M. Phil. dissertation, University of London, 1974.

[25] Alan Lee, "Seurat and Science", Art History, June 1987, 10, (2), p. 203.

his theory. Furthermore, Lee seems to make it a personal challenge to analyze Homer's stance regarding Seurat and goes to great lengths quoting from Homer only in order to correct him later on. While Lee is perfectly justified in trying to set the facts straight, and his analysis of Seurat's interpretation of Rood, Helmholtz and Chevreul are correct, one is left with the feeling that he has spent a lot of time dissecting the main argument into little bits before reconstructing the whole scenario again; a curious approach which produces little, if any, discernable change in the Seurat debate.

In 1987, John Gage published what appeared to be a rebuttal to Lee. The emphasis upon Seurat's use of science in the literature, which had remained largely unchallenged by Lee, was questioned again.[26] Gage begins his discussion by citing a quote from Homer and says that, although Homer seemed to have produced the most conclusive monograph on Seurat to date, the complacency of the scholarly world not to question some of Homer's conclusions or to investigate any further Seurat's "theory" has helped to maintain on-going misconceptions about Seurat and the state of science and theory in the late nineteenth-century. I fully concur and feel that, in the light of recent research in vision, the time has come for Homer's work to be amended, if not surpassed entirely in some areas.

Gage identifies three basic problems with Seurat's theory, which if Seurat had been more "scientific" he may have been able to avoid. The first regarded the notion of local colour which has no scientific support since colour is not a constant attibute

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[26] John Gage, "The technique of Seurat: A reappraisal", Art Bulletin, September 1987, p. 448-454.

of an object. Colours change with varying lighting conditions and what an artist perceives to be the local colour of grass, that is, green, is really the colours being reflected off the chlorophyll in the blades under those specific lighting conditions.[27] Secondly, the notion of Seurat's solar orange has always been accepted but has never been probed regarding its development. Seurat used this orange when he knew perfectly well that light was an aggregate of all colours; the only explanation Gage can offer is that orange helps to enliven and warm up the colours in a sort of visual approximation of the sun's physical warmth.[28] Lastly, the problems Seurat had with his use of complementary colours as he tried to impose the colours recommended by Chevreul on to the diagram developed by Rood were cited. Although Rood had based his diagram on the colours specified by Helmholtz's controlled research, Seurat seemed determined to stick with the less-specific colours suggested by Chevreul and thus saddled himself with a fair amount of confusion: had he been able to eliminate Chevreul's looser, and more interpretive system and adopt Helmholtz's scientifically grounded system, his work would have been vastly different.[29]

Gage also examines the size of the dot. He can find no relationship regarding specific hues and their optical fusion which cannot exist at any specific point since the dots in Seurat's pieces vary so much in size; apparently Seurat was more concerned with masses and tonal relationships than with colour, which held second place in importance.[30] Gage concludes that

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[27] Gage, "The Technique of Seurat: A Reappraisal", Art Bulletin, Vol., 69, No. 3, September 1987, 449.
[28] Gage, Op.cit., p. 450.
[29] Gage, Op.cit., p. 450.
[30] Gage, Op.cit., p. 452.

Seurat's technique was scientific but not truly representative of the time; Seurat found a technique which he could justify through his "science" and that was all he needed. Although Gage had re-introduced the examination of some pertinent questions regarding Seurat's "science", there are still questions which remain unanswered.

When one stops to consider the subject matter Seurat tackled, the scope and breadth of it, his seeming need to reform the means of painting, and his apparent desire to put Impressionism on a more systematic basis via a colour theory; surely, these varied goals mean that there had to be more to Seurat's method than just a strict application of science. The continued unquestioning acceptance in the literature of the effects of science on Seurat's technique was far too strong to remain unchallenged forever; the very notion of a scientific theory shaped by an artist, begs to be examined. The gaps between his colour theory and their application should have been analyzed and addressed much earlier; it really is amazing to think that one viewpoint should have persisted for so long especially when the general consensus was that something had gone wrong in Seurat's work.

Additionally, the ongoing tendency toward Formalism in the Seurat literature needed to be re-examined and a more Humanistic approach should have been brought forward; since, somehow, the more Humanistic interpretations of the 1930s seemed to have quietly disappeared. Seurat did not work in a vacuum, he responded to his surroundings and could not have functioned scientifically, like an automaton, without any personal input. Intuition and a sense of "what would work" are part and parcel of

any artist's approach. Seurat may have known what science would say about putting a red next to a green, for example, but the decision of where to place these colours, how large to make each colour and how often to repeat the combination were left to his decision. Stubbornly, the literature on Seurat seemed determined either to accept his "science" or condemn his failure in using that self-same science; there was no balance between the two.

However, rather than trying to answer the questions raised by the scientists regarding the viability of optical mixing within the visual system, addressing the problems regarding either the extreme acceptance or the attack on Seurat's approach or even, perhaps, considering the effect of the personal input from the artist, the literature on Seurat had begun to focus on other areas. During the 1970s and 1980s it became "fashionable" to focus on the social aspects and possible political and religious statements and intentions of the artist. The special issue monograph, "The Grande Jatte at 100", provides an accurate overview of this state of play in the literature on Seurat.[31]

The strongest trend during the past decade or so has been to interpret Seurat as a social artist who was motivated by the content or the meaning of the subject matter in that sense, rather than as an artist who was dealing with a visual science. This trend has been so strong, in fact, as to become almost compulsive for some researchers who seem able to infer Seurat's political inclinations or social comments from almost anything, however innocuous and innocent it appears at first.[32] While we

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31 "The Grande Jatte at 100 " , The Art Institute of Chicago Museum Studies catalogue, vol. 14, No. 2, Chicago, 1989.

32 In the beginning of his book Seurat: A biography, Rewald (1990) states that "The New Scholarship" aims to "...study Seurat's work for evidence of social, class, and family tensions of the emerging urban world, notably the

cannot ignore possible social commentary in Seurat's work, whether implicit or explicit, neither should we grossly skew an interpretation of a work to the exclusion of his technique and use of science. A balance must be obtained and although the majority of the pieces in "The Grande Jatte at 100" emphasize social, political and even religious interpretations, there are just enough contributions from others on the more technical aspects of Seurat's theory to maintain some balance.

The Seurat scholarship in this monograph, and most of it concerns La Grande Jatte specifically, looks at four issues: The first is the actual physical setting of the the island itself, analyzing its layout and how people could get to it; the second examines the people in the scene and looks at the social implications; the third views the canvas as a manifesto for a splinter group and sees how La Grande Jatte's exhibition fit into this institutional context; and, lastly, the fourth issue looks at how La Grande Jatte was received then as its critical context within the mid-nineteenth century is considered.[33]

Since La Grande Jatte was an experimental statement in the 1880s and has now become celebrated as a marker ushering in a new way of thinking, it is difficult to conceive of the skepticism and scorn it originally received because it was viewed as carrying radical social messages to the Salon viewing public; it challenged many of the then accepted viewpoints.[34] However, the

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radical political messages in his acknowledged masterpiece, La Grande Jatte." (p. 15) Rewald seems to straddle the fence of the Seurat approaches stressing Seurat's "conception of art" rather than his "technical innovations" to be more important and what we, today, should appreciate as Seurat's greatest contribution. I remain unconvinced and see this approach as trying to satisfy all sides without believing in one enough to merit any support.

[33] John House, "Reading the Grande Jatte", in The Grand Jatte at 100, The Art Institute of Chicago Museum Studies catalogue, Volume 14, No. 2, p. 116.

[34] House, Ibid., p. 127.

compilation of pieces from writers with varying approaches and orientations gives the reader a good feel for the situation; and, though this monograph is thorough regarding La Grande Jatte, one must be careful not to apply these conclusions to all of Seurat's later works.

The most recent viewpoints in the Seurat literature are presented in the exhibition catalogue put together by many of the noted Seurat authorities for the Seurat retrospective of 1991, the thrust of which was mentioned at the beginning of this literature review. Indeed, this catalogue provides the most comprehensive and up-to-date compilation of critiques and assessments on Seurat's artistic career which has been published to date.[35] Herbert addresses the almost synonymous association of Seurat and his science; in fact, the view that Seurat was the chief proponent of a "scientific" colour theory is "particularly in need of reappraisal."[36] He continues by saying that Seurat's association with science "has tended to obscure the fact that Seurat's technique grew slowly from his practice and is predominantly a feature of his craft."[37] Furthermore, as mentioned earlier in this discussion, what was considered "scientific" ultimately embraced a very limited amount of science as we would define science today; replacing the words "discipline" or "rationale" for science would, perhaps, be more accurate. With these statements, Herbert indicates that the literature is at last beginning to provide a more controlled

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[35] Robert L. Herbert, Georges Seurat 1859-1891. Exhibition publication, pub. Paris and New York, 1991. Contributions from Francoise Cachin, Anne Distel, Susan Alyson Stein and Gary Tinterow. Succeeding quotes will be from the English version published by The Metropolitan Museum of Art, New York.

[36] Herbert, Georges Seurat: 1859-1891, 1991, p. 3.

[37] Herbert, Georges Seurat: 1859-1891, 1991, p. 173.

assessment of Seurat as an artist--or at least is recognizing the need to do so. Seurat was not a driven machine nor was he a wildly crazy artist; he was a complex man who attempted many things, succeeded at some and failed at others.

Herbert continues his discussion and emphasizes that although science did influence Seurat, it did not strictly confine and direct the artist's approaches; colours vibrate not from the optical mixture science offers but from the broken colour application which Blanc had taught and Delacroix had used; colour contrasts are employed not because Chevreul dictated it so but because the artistic tendencies and inclination to do so were furthered and supported by scientific evidence.[38] Seurat found evidence for his craft in the writings of Rood and Chevreul; he used what he could immediately apply to his work, thus avoiding serious theoretical investigation.

The implication of Herbert's argument is that Seurat's theory was more a matter of circumstance than anything else. His "science" such as it was, was of secondary importance even though Seurat's arguments purport otherwise. There is too much subjective input evident from Seurat's written discourses for his work to be considered purely scientific; the work may appear methodical and scientifically applied but it is, ultimately, artistic.

From the present trend in the Seurat literature, if this publication is taken to be representative and just, I see a need not only to reach a balance between the effects of the pro and con science input argument in Seurat's theory and the wildly fluctuating pronouncements about the social, religious, and

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[38] Herbert, Georges Seurat: 1859-1891, 1991, p. 173-4.

political connotations of his subject matter but to establish, once and for all, just what Seurat's theory encompassed. My stance in relation to the whole body of Seurat literature is to agree with the latest "Herbert" approach while acknowledging the value of input from the social-interpretation circles. Seurat used the science of the day but applied it as an artist would; whether he intended further socio-political commentary is moot as far as I am concerned.

However, the point most in need of reassessment in the Seurat literature as a whole, is the tendency to say that, since Seurat's paintings do not provide the visual effects of light, he has failed as an artist applying science to his craft and, therefore, his theory, or what we perceive to be his theory, is false. In trying to answer the primary question "Does his technique work?", one cannot simply say, "No, it fails because it does not achieve the desired effect." That would be an incredibly naïve stance. There are simply too many things going on at once to be able to apply such a blanket reply.

It has become an increasing concern of mine, during the years I have struggled with the masses of material on Seurat, that, as each new generation of researchers enters into the academic ring and begins to refute and disagree with the prior generation's assessments, a precarious heap of arguments is being balanced upon one tiny starting point. If that starting point has not been identified or interpretted correctly, there is a very real threat that the entire structure will topple.

Since we are seriously short of primary source material concerning Seurat, we have had to rely upon commentary from his supporters as well as his critics; these are hearsay evidence at

best. So, not only are we trying to look back into time and understand what was happening in Seurat's day, we are also also trying to put together his "theory" from snippets of information. If we manage to construct something, it will only take one incorrect presumption to adversely affect the argument if not falsify our entire premise. If we build an incorrect theory, because we have incorrectly presumed Seurat's intentions to be one thing, when they really were another, we cannot possibly hope to judge the outcome in a fair manner. This is the tower of arguments which I now address; have we correctly identified Seurat's intentions?

We must determine whether we are attributing to Seurat a doctrine which he may not have actually held; if he did eventually hold such a doctrine, perhaps it was not formulated until much later in his career and we are reading back a late, schematized Neo-impressionist theory, in an overly rigid way, especially regarding his earlier pieces of Une Baignade and La Grande Jatte. What is the actual documentation, the hard evidence, that Seurat believed what we believe he believed at these earlier times--let alone later on in his career? These are the issues which now need clear re-assessment. Basically, we must address whether the foundation point of all of our arguments is correct.

Seurat painted in a specific time and era and his paintings had to reflect what he saw; I believe he had an ironic sense of humour and employed clever visual set-ups which only the serious observer would enjoy; his works certainly require concerted viewing to wrest the full message from the canvas. And only a concerted effort of studying all of the effects employed by

Seurat as well as those elicited from our eyes and our emotions will help us to more knowledgeably and assuredly answer whether his theory was "Spot-On or Not?".

Technical aspects to be examined

In addition to considering the dependence of Seurat's art on science as forming the basic premise for his theory, several aspects of his technique need to be examined in detail to see if they developed during his career or changed in emphasis from painting to painting. The balayé stroke, its origin and use; the dot, both its beneficial and detrimental aspects and the effects varying viewing distances had upon it; the visual games Seurat used and, indeed, demanded the viewer play in order to experience a painting's full effects; whether all of his études were meant to serve solely as studies or were created as more marketable pieces; and the amount of reworking done on some of his major canvasses as well as some of his études, will constitute the main aspects under study in the following sections.

Balayé (1st aspect)

The first aspect, the balayé stroke, was not a new contribution from Seurat; he simply used it in slightly different ways from those who had used similar strokes before him. The main question to be considered concerning Seurat's balayé stroke is: How does this stroke relate to Impressionism and in what way, if any, does it serve as a precursor for Seurat's more controlled pointillist stroke?

It has beecome accepted that the works of Delacroix and his frescoes in St. Sulpice in particular, were an influence on Seurat and helped to serve as a visual prompt for certain effects. Delacroix's frescoes were worked in an encaustic medium which, because of its waxy base, gives a thick effect when the colours are brushed on. The final effect is very soft; there is no one solid area of colour and subsequent layers of colour just

snag the tufty tops providing a soft, fluffy feel. Delacroix's use of balayé, in addition to the effects from the medium used, provided naturally blended subtle colour combinations.

The balayé stroke, as used by Seurat, is really different from the freer and looser Impressionistic stroke in that it maintains a specific cross-hatched repetition across the canvas or the area of colour to be defined. Seurat used the balayé stroke to lay in ground colour while the Impressionists had used the stroke, or strokes very similar to it, over their entire canvasses. Seurat's balayé was a short and quite choppy stroke, going in all different directions, while the Impressionists used a more fluid touch which also tended to be more aligned. Seurat's strokes were meant to lay in the ground colour before he added touches of other colours on top. How he made the stylistic change from the Impressionistic stroke, to the wildly choppy stroke, has not, to my knowledge, been examined. One explanation might be that, in Seurat's usage, the balayé stroke provided for some degree of optical mixing: as strokes overlapped each other and formed a painted "weave" upon the canvas, colours would blend to a degree; although, the primary colour perceived would be that provided by the balayéd ground colour with the added touches on the top merely toning the initial colour.

For example, Seurat used the balayé stroke in some of the studies for Une Baignade as well as on some parts of the final canvas.[1] On the final canvas, the balayé was used for the grassy areas; short strokes of a uniform length were applied in every direction. Additionally, in Man Painting a Boat, c. 1883, Seurat relied upon his diagonal balayé stroke to lay in the background

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[1] See Illustration 2.

and local colour with only a few horizontal and vertical lines to define the posts, building and the boat; indeed, in the grass and other areas of foliage are so systematically depicted that one senses the same result could be obtained from crosspoint stitching.[2]

The reliance upon the balayé stroke slowly decreased from Seurat's repertoire as his confidence with his colour theory grew. However, he only phased out the process of using the stroke as a underlayer and, therefore, main colour determinant, for the next layer of dots; the blending which he had achieved by interweaving the balayé strokes continued in a more modified form as his strokes became smaller and more regulated. It was not until after La Grande Jatte that Seurat began to rely more upon the visual blending of colours from small controlled coloured masses without having the benefits of a uniform ground laid in by balayé strokes.[3] The continued progession of Seurat's technique, with close attention to his stroke style, will be studied in the context of his paintings and their development in the chapters to follow.

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[2] See Illustration 3.
[3] See Illustration 4.

Dot to Dot (2nd Technical Aspect)

The great colourists have relied on the magic moment when we are close enough to a picture to see it change from a complete entity into its component parts, this is when we realize that the picture is just paint upon a canvas. The opposite is true when, up close, the viewer is still aware that what he sees is pigment but this effect begins to surrender with distance and the components begin to fuse until, at some point, it is lost completely. I think it was Kenneth Clark who called this process of finding the point at which the illusion breaks down and the components become apparent as "stalking the illusion". Chardin works with the knowledge that it is always paint and an overt awareness of pigment is always present; yet, conversely, there is a point where they coalesce into the illusion and the paint "disappears". The great colourists have always relied upon the tension which arises when the viewer suddenly becomes aware that what he sees is paint, when before or after this discovery he has not been conscious of that fact.

Seurat played this picture-paint-illusion game, too; he pushed and pulled the concept of seeing paint as paint, to seeing the subjects as being composed of paint to seeing just the picture. He then further complicated matters by attempting to use nothing but small controlled strokes of paint to depict everything on his later canvasses. It is his usage of the small touch of paint which, for purposes of simplicity, we will call the "dot", which constitutes the second aspect of his technique under study.

If Seurat's concepts are still attracting the viewer's fascination over one hundred years later, one wonders what the

initial effects of his canvasses were like. There is a certain mystery that his work touches upon, a basic interest in how things are built up. Molecules are the components of everything yet we do not see them with the naked eye. Normal paintings present to us a picture comprised of more or less blended patches of colour. Seurat, however, takes us into another realm by presenting us with his "molecules" of paint. Though we are fascinated to see the components there is some initial difficulty in reading them as a whole; we are curious to see the bits and, then, as soon as that curiosity is satisfied, we become somewhat uncomfortable to be presented with such detail.

Seurat certainly was not the first to employ such a stroke: divisionism was practiced by Rubens, Claude Lorrain, Watteau, Turner and Constable (amongst others) without much notice being taken until the Impressionists adopted the stroke[1]: Manet had his *tache* which literally translates as spot, splash or patch when referring to an artistic application; Delacroix used overtly separate brushstrokes in his epic canvasses in the 1860s; and both Monet and Renoir used strokes, dots, and commas to the exclusion of lines. However, Seurat's growing preoccupation of using quite small and uniformly shaped spots of paint presented some very definite obstacles for the artist and viewer alike.

The first of these obstacles was how Seurat could maintain the "visual feel" of a particular surface if he used nothing but uniformly sized and shaped strokes or dots. The surface of silk is different from skin, and both vary from tree bark; yet, if all are depicted via dots, how could he indicate the differences amongst the surfaces' textures? Beyond indicating different

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[1] Faber Birren's introduction to Rood's Modern Chromatics, New York, 1973, p. 22.

surface textures, he would also need to show the varied play of light upon a single surface; for example, in watery areas he would need to retain the sense of "water" with its inherent sheen, as well as showing how light reacted upon the ripples.

Secondly, the difficulties of presenting precisely produced dots which are equally sized and randomly placed so that contours are not defined by lined-up dots, and are juxtaposed perfectly so that one is never aware of clusters of a single colour, are almost insurmountable--to a mere human being; machines, of course, do this effortlessly for colour printing processes. The variations in shape, alignment and density of the dots indicate how much Seurat's intuition still controlled him, even though he strove to be as systematic as possible. The variations do not, however, necessarily imply a failure of his method.

Dunstan believes that the way in which that Seurat's dots were very flexible and never mechanical was part of his charm, while another writer states that although the touches of colour vary in size and placement, they are not unpleasing because they assume an "architectural role".[2] Herbert states that Seurat's dots "are not even dots--they are instead small touches of paint in various shapes that shift and flow with the images and are interlocked with the underlying paint", and then adds that it is the later canvasses which seem to be covered with a network of fine dots and that the size of the dots shrinks as time passes.[3]

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[2] B. Dunstan, Painting methods of the Impressionists (Rev. ed. in colour), New York, p. 107. And, Jean Sutter, ed., The Neo-Impressionists, section by Robert Herbert, "Seurat's Theories" , London, 1970, p. 31. The implication is that although the viewer is aware of the lack of uniformity amongst the strokes, the fact that the strokes blend together to form something greater is more important.

[3] Robert Herbert, Georges Seurat: 1859-1891, 1991, p. 5. This belief originated in Signac's D'Eugéne Delacroix au néo-impressionnisme, chapter one, where the basic tenets of Divionism were laid out; the size of the

As I will discuss in greater detail later, I do not find this to be the case; Seurat's later canvasses were smaller; thus, the dots were also smaller and more controlled. However, this does not suggest to me a canvas-size to dot-size ratio nor does it necessarily illustrate greater precision in dot size; rather, I believe that Seurat's technique became more controlled and methodical with time. Furthermore, since none of Seurat's later canvasses were as enormous as his first two major pieces, it would seem logical that the dot size would decrease since, physically, there was less space to cover.

However, saying that, I am always struck by the tiny, final layer of dots in La Grande Jatte. They are miniscule when compared to the size of the canvas.[4] This could be due, in part, to the fact that Seurat re-worked the canvas years later; yet, in general, I fail to see the expected decrease in dot size with the progression in time of his theory. Some of his marines may exhibit more of the controlled qualities in dot application and size which Herbert cites, but one does not have the sense that the dots vary consistently in response to the canvas size or decrease measureably over time.[5] Small canvasses would require smaller dots yet some of Seurat's good-sized marines have tiny dots in the darker colours while the lighter hues are still fairly substantially sized. Perhaps this is because lighter colours will "blend" at a lesser distance than the darker colours and, to get all the colours to "blend" at once, the darker-coloured spots had to be smaller. All of these issues will be

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brush stroke being commensurate with the canvas size was the last directive mentioned.

[4] See Illustration 5.

[5] See Illustration 6.

considered when Seurat's later paintings are examined in greater detail.

It has been mentioned by many writers on Seurat and other artists who employed pointillistic techniques, that one of the greatest advantages of this technique is that subtle changes may be brought about with infinitely great degrees of control. Perhaps one of the most elegant arguments against the benefits of pointillism was made by Lee when he compared pointillism with traditional painting methods and then with mechanical reproduction.[6] Colours in paintings may be modified through traditional repainting of entire areas or by gradual changes in tones of the dots. However, Lee feels that it is precisely the seemingly "advantageous process of continuous modification in pointillism (which) actually precludes the possibility of subtle control."[7]

Lee illustrates his argument by showing two square areas, one with a regular, geometrical arrangement of identically sized black spots and the other with varying sizes of black spots which have been determined to have the same overall visual density as the first square (see illustration below). When the first square is viewed from a distance, it will quite readily resolve itself into a grey tone. When the second square is viewed from a distance, it will never resolve into a uniform grey tone, it will always remain uneven; and if, perchance, some degree of uniformity were achieved, the tiniest addition or deletion of a spot would destroy that. The only way to change the tone of the first square would be to enlarge or shrink the dots, putting in

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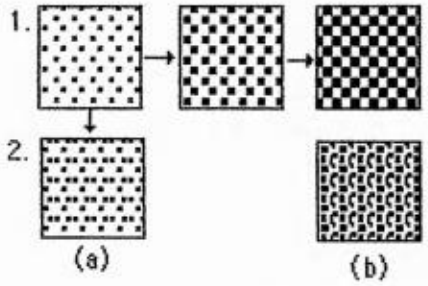
[6] Alan Lee, "Seurat and Science", Art History, Vol. 10, 2, June 1987, p. 214-215.

[7] Lee, Op.cit., p. 214.

more or taking some out would disrupt the regularity. This, says Lee, shows that "...continuous modification and perfect control are mutually exclusive."[8]



Only changes in the size of the dots will produce tonal changes in a regular pattern of dots. Adding random dots, as in 2a, produces irregularity and tonal changes. 2b represents a pattern similar in tone to the final one in the first row. It must be noted that these changes only apply to black-and-white.

Lee's argument against pointillism is neat; however, his illustration involves black and white dots and regards a change in the tone of the overall area. Seurat used colour and, if such an experiment were replicated in colour, changes in intensity would be noted with increases and decreases in amount or size of dots while changes in hue would be noted with the introduction of another colour. An elegant argument yes, for black and white pointillism; but for colour, it fails to translate equally well. The fact that Lee's argument revolves around a point which concerns black spots must be kept in mind when considering Seurat's colour pieces; it does not necessarily provide evidence against the efficacy of colour pointillism.

Thus, when judging how well some portions of Seurat's reworked canvasses and his final paintings "work", one must not be tempted to apply Lee's concluding argument--that pointillistic modification and control are mutually exclusive--in all situations. Seurat's later, more pointillistic stages are different from his earlier pieces even though they all used "The Dot" to some degree and, all of his dots were in colour and not

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[8] Lee, Op.cit., p. 214.

in black and white. As Herbert remarks about Seurat's smaller touches of colour, "...it is evident that they permitted extremely subtle variations of colour, serving Seurat's wish to express extraordinary nuances of hue. One could add a colour, or change its gradation, by the application of another set of touches."[9] Again, pointillism techniques with colour will create variations in tone, hue and, perhaps, saturation, while pointillism in black-and-white only affects the tone. Even so, in Seurat's earlier pieces, it should be kept in mind that many of his touches do not determine the final colour; they only contribute to it while the first, and local colour, maintains visual predominance.

Viewing Distances (3rd Technical Aspect)

Running concommitently with "Seurat's Dot Approach to Painting" is the "Suggested and Ideal Viewing Distance". As it will be discussed in the next section on "Visual Games", the viewer must be willing to move back and forth in front of the canvas to find the point where fusion is likely to occur. Callen believes that Seurat's colour spots were "...not intended to fuse completely on the retina, for the dots were generally too distinct for that. Rather, when seen at the appropriate viewing distance, which was considered to be three times the length of the pictures' diagonal, the incomplete fusion of the coloured dots resulted in a flickering optical sensation."[10] Dunstan, too, believes that the dots were not intended to fuse optically and create greater luminosity but that the optical vibration, created

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[9] Herbert, in Sutter....p. 32.

[10] Anthea Callen, Techniques of the Impressionists, London, 1982, p. 113. The origin of this formula can be traced to Pissarro (See Homer, 1964, p. 294, Note 103).

by a sort of borderline fusion, was the goal.[11] Whether or not the dots fuse, and, more importantly, whether Seurat believed that they would fuse, is an argument to be settled later; for now, the viewing distance must be examined.[12]

If one takes the previously suggested formula for an ideal viewing distance, then a viewer would have to stand some 35-1/2 feet away from La Grande Jatte in order to experience the flickering sensation. From personal experience, I found that any distance beyond 15 feet resulted in flat colours with no flickering effects. Using the same formula, a viewer would have to be just six feet away from La Parade to experience maximum "flicker"; again I found a better viewing distance to be about 15 feet. Although La Parade is just a fraction of the size of La Grande Jatte, approximately the same viewing distances were the most comfortable ones for me.

This indicates that some other factor is having an effect and one cannot simply indicate a viewing distance by multiplying the diagonal of the canvas by a figure. Most obviously, the size of the dots and the layers of applications of dots will effect the ideal viewing distances. Then again, La Grande Jatte was an outdoor scene with light and shadow while La Parade was a nighttime scene with gas-lit highlights; each of which would entail a different approach to achieve the desired lighting effects.

A microscopic enlargement of a paint "stroke" in La Grande Jatte reveals that there is first a large, flat, rather thin

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11 Dunstan, op.cit., p.101.

12 This argument also rests on the basic premise that Seurat's intention was to achieve optical fusion. I believe this falls under the on-going mistaken argument mountain, as discussed in the Introduction, and that Seurat was really striving for the optical flicker knowing, perhaps instinctively, that complete fusion would prove difficult due to the numerous factors involved.

layer brushed on as a background colour; then smaller ovoid blobs of paint which are thicker and somewhat directional lie on top of the first layer; and, then, the final layer has rounded "gobs" of paint.[13] Perhaps only another, similar microscopic enlargement of a section of one of Seurat's later canvasses will prove with any degree of certainty whether he achieved the supposed goal of using small, perfectly formed dots. Until such a time, however, one will not be able to apply set rules for the best viewing distance and personal judgement on the viewing distance will have to suffice.

It appears that the more one investigates Seurat's theory, the more complex it becomes and, I would suspect, it would be quite difficult if not nigh on impossible to state conclusively any viewing distance formula which would suit all of his works. Greater attention will be given to the dot, its usage and importance in Seurat's theory as each of his major canvasses are studied in the chapters which follow.

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[13] Inge Fiedler, "A Technical Evaluation of the Grande Jatte", The Art Institute of Chicago Museum Studies catalogue, Vol. 14, No. 2, Chicago, p. 171. See illustration 7.

Visual games (4th Technical Aspect)

How would Seurat have expected his paintings to be viewed? This question, above all others, must be of prime importance to a painter who is investigating optical effects in his work. Seurat was working on so many different visual effects in his canvasses that a viewer who was unaware of his goals might miss out on the chance of experiencing some curious sights; without an invitation to "play the visual game" from Seurat, such a viewer would be ill-equipped to appreciate much beyond the first visual impressions. The visual games which Seurat initiated were not meant to be trivial; rather, they involved a series of perceptual challenges which only the most persistent of viewers might appreciate. There are four visual games which we will be considering and brief examples are provided here; more detailed discussions and examples will be provided in the discussions on individual paintings.

As we have seen, one of the major visual games Seurat would have offered involved viewing distances. Although the "proper" viewing distances and its effects were discussed briefly in conjunction with the aspect regarding dot size, surely Seurat would have expected his works to be viewed at varying distances. His larger canvasses could not, if ever, be seen in a predetermined way as a whole. This is true of all the large academy-sized paintings in which part of the effect for the viewer must be made in looking more closely than at a range which can embrace the whole canvas.

Large history paintings, like those by David or Ingres, lose much of their visual impact when they are viewed in reproductions or illustrations; one simply cannot visualize the real-life size

of these pieces when they are represented in a book. The Sistine Chapel ceiling, a Gericault and a Seurat, for example, could all be visually presented in a 5 x 7" format; yet, obviously, none are equally sized in real life. When such large paintings are viewed in real life, it is physically impossible for the viewer to see the scene up-close as a whole--especially if the figures are life-sized--so the viewer must walk the length of the canvas and view single portions at a time. Seurat's canvasses, however, must be handled on an "approach and retreat" basis rather than by the more classical methods. Therefore, Seurat's canvasses do not require the viewer to "walk through the canvas" per se but rely more upon the visual game of the viewer moving nearer and further from the canvas in order to receive its full effects.

When studying large canvasses, at some point the viewer has to stand far enough away from the work in order to be able to encompass the entire scene at one time. This is especially critical with Seurat's works since this greater distance causes details to be lost and the luminosity factor in Seurat's work vanishes completely; the colours meld into a nebulous grey or become dulled at too great a distance. However, these losses are only suffered when the viewer remains at a fixed and, perhaps, improper, viewing point; movement to and fro allows some factors to increase in importance while others fade and vice versa; this is the visual game of distance which viewers of Seurat's works must play.

Although this game will be illustrated in greater detail later on for some of Seurat's large canvasses, the study of the smaller version of Les Poseuses by Homer will illustrate the

importance of viewing distance on Seurat's works.[1] Homer began to study this canvas from a distance of fifteen feet and found the majority of the colours to be desaturated and rather neutral in appearance, only the warmer colours retained any intensity; moving closer to about nine feet brought a slightly greater indication of warm and cool colours; at a distance of six feet Homer experienced lustre even though there was still a considerable amount of visual fusion; and, at a distance of just three feet from the canvas, the effects of lustre became diffused as the individual colours became singularly and sharply apparent since their intensities increased because of the interplay with the complementary colours.[2] Homer supports his contention that the distance of three to six feet is the optimum distance for this canvas by mentioning Pissarro's rule (for viewing distance multiply the diagonal measurement of the the canvas by three); thus, for the smaller version of Les Poseuses the viewing distance is 6.12 feet.[3]

Another visual game arising from Seurat's paintings concerns the colours in his compositions. Obviously, he was interested in how objects worked in his compositions and the effects of light on colour across and into the depth of the canvas in terms of the relationships between the forms. The intervals in space and the colour subtleties required to indicate depth in space became an obsession for him. He developed a compulsive need to attend to the visual means and focussed a remorseless attention on all of the visual possibilities. Seurat did not just show the shaded

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[1] Homer, Seurat and the science of painting, Cambridge, 1964, p. 172-174. See Illustration 8.
[2] Homer, Op.cit., p. 172-173.
[3] Homer, Op.cit., p. 294.

and the lit areas of the canvas; he presented how colour was transformed between shade and light by giving the viewer the full visual impact. Again, the more the viewer was aware of Seurat's visual game of colour, the more the viewer would benefit from what the canvas had to offer.[4]

Seurat's concern with the interplay of light as it moves across the space and impinges upon forms was taken into a further dimension in the canvas Les Poseuses.[5] In this painting, La Grande Jatte is shown to be hanging upon the wall in Seurat's studio behind the models and props he used for the scene; it is a visual-game-within-a-visual-game. One begins to wonder how far he deliberately altered the colours in La Grande Jatte because it is now shown in the interior setting of his studio which would have been lit by artificial light. If we presume he did alter his palette to account for these lighting differences, the question which arises is whether this was done on purpose or simply due to changes in the evolution of his theory over time. If the tonality of La Grande Jatte was also changed to accommodate for the representation of an outdoor scene being shown indoors and under artificial light, did he then further account for the fact the La Grande Jatte is now being viewed at an angle? Did his brushstrokes change to account for this or do they match those in the original canvas?

A viewer can carry on forever looking for changes and similarities, trying to assess what appears to be a critique of

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[4] Several scholars have suggested that Seurat's palette was so precisely determined that he could continue painting in varying light and be assured of getting the results he desired. Obviously, if he worked outdoors and then used posed studio models to populate the scene, he would be working with very dramatic light changes. A theory would have to be infallible for an artist to assuredly combine such different components without fault.

[5] See Illustration 8.

an earlier work or just take it as read, since La Grande Jatte was on the wall behind the models and it was included in the new painting. Though, for an artist of such a determined nature who seemed to thrive on analysis and planning, I cannot accept that the presentation of La Grande Jatte in Les Poseuses was mere happenstance; it is, I believe, yet another visual game from Seurat.[6]

The last visual game to which viewers should be alerted concerns the length of viewing time. Although other reviewers have mentioned the (respective) impact of lighting differences and distance differences upon the viewing of the canvas, little has been said about the changes noticed during the time being spent in contemplation of a Seurat canvas. If a viewer is fortunate enough to have clear access to a Seurat canvas, then standing for at least two minutes in one position from a distance of approximately 15 feet--or whatever distance is comfortable enough to see the entire canvas at one glance--will reveal some intriguing visual occurrences.

Visual tricks begin to appear with prolonged viewing as the receptors in the eye become fatigued. For example, curious visual effects begin to occur after viewing La Parade continuously, from one point, effects which would not have been noticed if the viewer had moved.[7] The colours begin to develop a sort of shimmer and the figures themselves become less distinct regarding their placement in the depth of the picture field. Part of these may be due to visual fatigue, which is discussed in greater detail in Chapter Five, but I think Seurat was well aware

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[6] The discussion of this canvas is continued in detail in Chapter 5.
[7] See Illustration 9.

of these phenomena and strove to intensify those effects he could alter. Seurat stood in front of his canvasses for hundreds of hours while he painstakingly created them and he must have experienced numerous optical inconsistencies while he worked; not only would he be working with different colours and distances as well as the effects of visual fatigue, but his extreme closeness to the canvas must have been perfect for the "out-of-the-corner-of-the-eye" effect.

Anyone who has ever tried to identify the colour of an object in fading light or been unable to see details in darkness will be able to experience these "tricks" which arise during an extended viewing of Seurat's canvasses. The visual phenomena being experienced, namely involving peripheral vision, will be discussed in detail in Chapter 6 while one of his most visually exciting canvasses, La Parade, is discussed in terms of these visual tricks in Chapter 5. For now, it is enough to be aware that the visual game involving length of viewing time is there, whether or not it is readily apparent to the viewer in the conditions in which he finds himself.

Études or not? (5th Aspect)

Some of Seurat's études seem to be just that; smaller versions of the final piece meant to serve as quick visual references. Others, however, are meticulously thought-out and detailed pieces and are so complete that they could have passed for a finished painting if one didn't know that the major canvas had been done afterwards; or, as in the case of the smaller version of the Poseuses, done beforehand.[1] Why was this discrepancy in the style and finish of Seurat's études so apparent and did it continue throughout Seurat's career?

Some of Seurat's studies were so self-consciously composed that "études" really is not a proper label in the literal sense.[2] A differentiation needs to be made. Functional études can be understood as part of the process of design. They may be differentiated from the études which, to all intents and purposes, are complete works by being poised, balanced and unified. Seurat's Beaux-Arts training would have taught him to progress through multiple small studies and a modello before squaring up the piece and transferring it onto the final canvas. However, when most of his études are viewed on their own, relatively few could be considered studies in either the Beaux-Arts sense or the strictest sense of the word; rather, some appear to be quite marketable reductions of the final version.

Artists from the Renaissance onwards have designed their large works carefully and precisely; they worked out the component parts and how each part worked alone and then in

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1 See Illustration 8.

2 I am using the word "étude" and "study" interchangably. I will not apply the differentiations between esquisse and ébauche to Seurat. His études examined so many different aspects of a particular project, with so few falling into any specific progression, that I cannot comfortably identify specific esquisses and ébauches from études.

conjunction with others before fitting it all together. Usually a tight working model was needed before beginning the final piece. Yet, if Seurat had followed this method of working and each of his studies had referred to a component part of the whole, why would he then put in borders or go back and re-work a étude as his theory changed?

The large "study" for La Grande Jatte in the Metropolitan Museum in New York is certainly marketable as a complete and finished piece on its own merits.[3] It has a border, an internalized addition of dots inside the border and it vibrates with colour and light. Other "studies" for La Grande Jatte are complete and exhibit finished brushwork, complex colour systems and, in some cases, painted borders.[4] Some of the studies for Les Poseuses are, to me, far more visually intriguing, satisfying and well thought out than the final version.

Conversely, for both Les Poseuses and Le Cirque, there are studies of key figures for the final versions in conté, graphite and pen and ink which are most definitely incomplete working studies.[5] Close x-ray examination of the Metropolitan's study for La Grande Jatte shows a grid was laid underneath which indicates this is an enlargement from a smaller study.[6]

Why then, is there such disparity between the style and technique of Seurat's études over the span of ten years? The answer may lie, in part, in a slightly different interpretation of Seurat's work.

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[3] See Illustration 10.
[4] See Illustration 11.
[5] See Herbert, Seurat, 1991, p.369.
[6] See illustration number 10 and the discussion on this work in Herbert, Op.cit., p.211.

The disparities in produced pieces and working methods may suggest alternative uses for the works or alternative goals for Seurat to which only he was privy. Herbert has suggested that some of Seurat's works were separate studies and were, seemingly, not ever intended to "fit into" the final composition.[7] The measurements of the majority of Seurat's études are 15 x 25cm although some measure up to 6cm longer and 3cm wider. Études for the larger canvasses encompassed either a portion of a final canvas or comprised almost all of the components of the final painting; obviously, those studies comprising all the components had to be very tightly controlled.

A influencing commercial factor might be that the smaller, more tightly controlled versions would lend themselves more readily to sales. However, there is no mention of Seurat ever having proceeded with such ideas in mind. He had to produce each piece, over and over, by hand, as he incorporated his various changes; thus, producing fairly complete small études would be easier before proceeding to the larger canvasses. For example, the fact that he painted the smaller version of Les Poseuses after he completed the large canvas was simply to continue his experimentation with colours and techniques in as quick and efficient a manner as possible. So, if he was not producing complete, intricate and finished études for ready cash sales, what was the reason for these vibrant pieces and how do they fit into the scheme of Seurat's theory?

Some of the earlier studies for both Une Baignade and La Grande Jatte are fresher, brighter, and maintain a vibrancy which

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[7] Herbert, Georges Seurat: 1859-1891, p.5.

fails to translate in an identical manner to the larger canvasses.[8]

Since these qualities are not apparent in the larger canvasses, this does not necessarily mean that Seurat's theory has failed in the final stages; although, this has often been given as the final judgement. If Seurat knew he could obtain the "glowing" visual effect on the smaller scale of his études, he may have decided to achieve something a bit more durable on the larger-scale canvas knowing that the "glow" did not transfer well to a larger scale.

As an experienced and well-trained artist, Seurat would have known of the changing qualities of pigments and undoubtedly he would have run across some poorer quality pigments whose changes would appear rapidly and distort the final effect. In order to achieve some of the sense of the flickering, fleeting, vibrant qualities of the études, but in a manner which would not have him relying upon uncertain pigments for these effects, Seurat would have had to rely upon visual effects, other than those from the pigments, to help him succeed in his goals. If Seurat could transpose the shimmering, changing feel of light onto a larger canvas by changing the size of the coloured spots, mixing the coloured spots in different combinations, or by forcing the viewer to move about and change viewing distances, he could still present an opportunity to experience visual effects. For example, "Now you see it, now you don't" is the built-in flicker game which Seurat has employed on his larger canvasses to provide and elicit identical effects and responses to those produced in the études.

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[8] See Illustrations 12 and 13.

Although, initially, the études may seem more alive, with time they may dull. Seurat's built-in effects on the larger canvasses, however, will not dull; the dots will not move about nor will they change in shape or size. Seurat has managed to imbue these larger pieces with a sense of something enduring, permanent and classical. Thus, the intermitent and fleeting visual effects from the pigments which one experiences when viewing Seurat's études has been made more permanent in his larger pieces via pre-determined built-in techniques.

Reworked or not? (6th Technical Aspect)

The basic question regarding Seurat's re-working a painting forms the next topic to be studied. Generally, without substantial documentary evidence to the contrary, some sort of scientific testing which firmly dates any later applications of pigment, or features which are glaring and anachronistic in terms of an artist's normal technique, one must abide by the presumption that paintings or études were painted and then left alone without being reworked or retouched. It would be unjustified and pointless to assume anything else. However, in Seurat's case, there are documented instances of his reworking canvasses years after the initial painting was done, sometimes reworking a reworked canvas, and sometimes reworking an étude.

In Une Baignade, for example, there are little yellow dots over certain areas of the surface which are vastly different from any other of the original paint strokes on the entire canvas. Due to the very different size and application of the paint strokes, these would appear to be later additions to the canvas and indeed, documentation supports this.[1] Furthermore, it is well documented that La Grande Jatte was reworked and, visually, this is confirmed by the network of small dark dots over the final layer of paint on the canvas.[2] In both of these cases, documentation supports what appears to be a discrepancy of Seurat's style.

As was mentioned earlier in the discussion on the nature of the études, it simply does not make sense to rework a study because the very nature of a study means that certain aspects

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1 See Illustration 14.
2 See Illustration 15.

were worked out to test a particular effect; thus, a study should have served its purpose once these tests are done. Granted, one might argue that something as novel as a painted pointillist border technique would be best tried out on the smaller scale of an étude first; beyond that, any later reworking of an étude seems an exercise in futility when considered in purely functional terms.[3]

However, the Étude d'ensemble(1884) for La Grande Jatte is regarded as having been reworked 2 to 3 years after it was originally painted.[4] The small yellow strokes running around the inside of the border, which appear to be the visual misfits on the canvas, and which are cited as support for later reworking, are no different from the strokes used on canvasses which were painted years earlier. Pontaubert was painted in 1881 and has little, tiny dots over specific sections of the canvas yet it has not ever been suggested, to my knowledge, that this canvas was reworked.[5] Why then, should a canvas which was painted years later with dots which were anachronous to that canvas but not to a style Seurat had used before then proclaimed to be the result of reworking? I do not see that the little dots in Pontaubert are any more conspicuous than those in this particular study for La Grande Jatte.

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[3] It is interesting to note that in the Georges Seurat (1991) catalogue, Herbert makes a comment of borders being added later but the quirky aside of this information is in the wording "probably by Seurat". This immediately raises the question "If Seurat did not add this border, who else would have and why?" It would seem out of character for Seurat to let anyone else near his works and I have not come across any reference of Seurat making use of apprentices. If a border had been added by someone else, would the colour theory have been adhered to or would the border simply "finish" the painting by continuing in its special style?

[4] See Herbert, Georges Seurat: 1859-1891, p. 209-211. Many études and canvasses seem to have been adjusted and altered by Seurat after their completion.

[5] See Illustration 16.

In cases where documentation does not exist, and analysis has not been done on the pigments to ascertain possible changes in their composition and age, only supposition about reworking can explain discrepancies in Seurat's painting style. Again, as this study continues, new patterns may begin to emerge in Seurat's style, although his short-lived career will work against us in determining any continuing patterns, especially since he experimented with so many different techniques.

Closing remarks

The review of the literature and definition of certain problems was presented in order to encapsulate the continuing state-of-play in the Seurat literature before the main issues to be examined in this study were enumerated. The aspects of the balayé stroke and its evolution; dots and their viewing distance in Seurat's colour theory; visual games; the "real" role for Seurat's études; and, the amount of reworking done to his canvasses, will be considered in terms of the "science" Seurat used at the time as well as for their viability after the scientific advances of the 20th century have been examined. The next section will introduce the volatile state of the Parisian art world in which Seurat was trained and matured before it examines the development of his theory from his earliest drawings through his tentative colours studies and towards his first major canvas of Une Baignade.

All of this will be done under the main consideration that Seurat was an artist who applied science as he interpreted its results and as he needed its knowledge; he worked in an art world full of motion which moulded him while his theory changed due to its own growth as well as that of the world's.

CHAPTER TWO

TOWARDS UNE BAIGNADE:
Art environment in 19th century France

In a crucible of early modernist ideas and against a background of political ferment, scandal, and at times, violence, Paris had managed to become the artistic heart of Europe in the mid-nineteenth century. The almost total centralization in Paris of government, commerce, banking, theatre, publishing, and scientific and medical research concentrated within the city a great proportion of the country's talent and wealth. It was in this exhilarating atmosphere that writers, painters, and musicians embarked upon a half century of experimentation and it was in this overtly progressive mood that a group of artists, eventually called the "Impressionists", finally broke free from the hold of the official Salon. The changes which occurred during these years had a direct influence on Seurat as his art, and that of the Neo-Impressionists, grew out of and along with the Impressionist movement.

The first Impressionist exhibition was held in 1874. Its members were all experienced painters and all had undergone the usual Beaux-Arts training; though their leaving the Salon generally was taken to be an act of defiance and was seen by some as a sudden and outrageous movement, in reality "...it was the culmination of a slow and consistent evolution."[1] As an alternative to the official Salon, the Impressionist avante-garde stood for the "independence and freedom of the artist" which,

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[1] John Rewald, History of Impressionism, London, 1973, p. 8.

inevitably, brought in a political dimension, regardless of the original motives for the group's formation.[2]

Impressionists such as Monet, Renoir, and Degas were concerned with capturing the sensations of light and colour in their evocations of a scene; hence, their name arose out of this urge to depict their impressions of a scene. They wanted to treat the subject matter in terms of light, stressing the atmospheric colours rather than the local ones and focussing in particular on colours in the open air. Their work was quick and exuberant and relied upon the freely-applied broad brushstrokes of bright colours to the exclusion of lines; further new techniques for the strokes evolved as instinct and instantaneity became their driving forces.

Noble as the sentiments may have been, though, most of the spectators and many of the critics failed initially to appreciate the motivation behind the Impressionist movement and could not adjust to this artform. The general feeling was that Impressionism was just too radical and employed too abrupt a change from the accepted style for it to be embraced comfortably. Yet, the Neo-Impressionists', and Seurat's, later attempts at accommodating for the Impressionist's abrupt style changes by imposing a more regimented structure in their approach, also failed to satisfy the viewers. Thus, the negative feelings towards the Impressionists' art remained little improved toward the Neo-Impressionists.

Gombrich has said, "If all seeing is interpreting, all modes of interpretation could be argued to be equally valid."[3]

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[2] John House, Seminar: "Seurat and the Politics of the Avant-Garde", The Metropolitan Museum of Art, 4 October 1991.

[3] Gombrich, Art and Illusion: A study in the psychology of pictorial representation, London, 1960, p. 298.

If this is indeed the case, or should have been the case, what went wrong with the Impressionist style and then continued to go wrong with the Neo-Impressionist's attempts? When the new artist or movement makes concerted efforts to correct for criticised aspects of the prior artist or movement, one wonders why things still go wrong. If the Neo-Impressionists had made concessions for earlier identified criticisms toward the Impressionists, perhaps the fault in the basic artistic process lay with the reception of the art rather than with its presentation; perhaps, as was discussed earlier, the public simply had not learned how to "see" as the Impressionists' and then the Neo-Impressionist's had intended. Regardless of the reason for their public's slow acceptance and approval, Seurat and his fellow Neo-Impressionists continued experimenting with the process of visual discovery.

Out of Impressionism arose artists such as Cézanne, Gauguin, Lautrec and Seurat, who, even from their very different standpoints, felt that too many of the traditional and potential elements of painting were being neglected in the search for a momentary expression of light and colour. They believed that Impressionism had focussed too much on the analytical first stage; Impressionists had not gone far enough in the whole process; they needed to select certain impressions, heighten them and then recompose them into the final form.[4] These new artists felt that more structure was required for the studies of form and space, that the expressive qualities of line, form and colour should be given more attention while still retaining the fresh approach to light that the Impressionists had stressed; in short,

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[4] D. Rich, Seurat and the evolution of "La Grande Jatte", New York, 1969, p. 45.

forethought and permanence became the Neo-Impressionists' driving forces.

The Neo-Impressionists sought for what was permanent and durable in order to "...conférer `a la nature, que laissait `a la fin sa réalité précaire, une authentique réalité".[5] By selecting images from the real world and presenting what they perceived as the purest essence of the forms, the Neo-Impressionists felt they were improving upon the imitative, conventional and immediately reactional form of art which had existed in Impressionism; they felt their emphasis of mental interjection into the artistic act made the final piece superior to that of the Impressionists'.[6] Seurat, in particular, focussed on and accepted the colour usage of the Impresionists with one extra factor; he felt that making the artistic process more precise would help to alleviate some of the problems encountered by the Impressionists.

During the 1870s the Impressionists had begun to change the layout of their palettes from the more usual tonal spread of white to black to that of a spectral orientation; however, earth colours and black were still being used for contrast. The Impressionists preferred a mat paint surface and mixed white with their colours in order to achieve more reflection of light from the painting's surface; using oil-free paints and not varnishing the finished paintings furthered their aims.[7]

The Neo-Impressionists adhered to the Impressionists' basic colour tenets but they were able to improve upon some aspects of

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[5] Paul Signac, D. Eugéne Delacroix au Néo-Impressionisme, Ed. La Revue Blanche, 1889, p. 76. (...to confer authentic reality on nature tired at last of its precarious reality)
[6] R. Herbert, "Seurat's Theories", in Sutter's, The Neo-Impressionsts, London, 1970, p. 38.
[7] A. Callen, Techniques of the Impressionists, London, 1982, p. 109.

the first group's approach since they were not so controlled by time constraints on the painting process. Neo-Impressionists could prepare their palettes in advance to represent light as they thought best while the Impressionists had been forced to capture light as best as they could at any given moment. The Neo-Impressionist palette was laid out in a spectral order but the earths and blacks were eventually eliminated since they were thought to dull the final effects. Neo-Impressionists also used a very absorbent ground on the canvas which drew out the oils from the paints and thus increased reflection of light off the matt suface.[8] Seurat adhered to these new ideas and used opaque paint layers in his earlier canvasses (1880-1885) to cover the absorbent grounds--which were white or coloured--although some studies still show traces of this ground.[9] Thus, basically, the colour approach for the Impressionists and Neo-Impressionists remained the same; mat surfaces and pure colours were used to obtain the greatest interplay with light which was possible.

A New View

In order for their art to be true and accurate, the Impressionists felt they had to depict what they saw without visual preconceptions; they were to serve as a channel for presenting the scene to the viewer without contamination from stock methods of naturalistic illusion. Throughout history, new art movements and trends have each depicted the world in what usually and eventually became the accepted and approved fashion of the time. One major strand of innovation during the nineteenth century strove for an unbiased recording of visual

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[8] Callen, Op.cit., p. 109.
[9] Callen, Op.cit., p. 110.

facts. Avoiding contamination from subjective interference as much as possible was, in very general terms, the Impressionist stance. Gombrich continues,

> "The technical term for this outlook is the belief in induction, the belief that the patient collections of one instance after the other will gradually build up into a correct image of nature, provided always that no observation is ever colored by subjective bias. In this view nothing is more harmful to the scientist than a preconceived notion, a hypothesis, or an expectation which may adulterate his results."[10]

Although Gombrich specifically pitches his last sentence towards the approach a scientist makes in his work, the same sentiments apply equally well for the empirically-minded artist and, generally speaking, the main group of Neo-Impressionists.

Seurat's theory developed at a time when explanations which had been taken for granted were now being questioned. It became apparent during this time of exploration that distinctions needed to be made between seeing, or what is really seen and sensation, or what is the result of the mind; sense, knowledge and inference are all similar, yet quite distinct terms for various aspects of perception.[11] Seurat's approach, and what developed into his theory, were meant to aid him in this quest.

The Neo-Impressionists tried to move toward the type of visual truth which the Impressionists had dictated even though they still remained constrained by the basic disparity between what was seen and what was known. Perception begins with human eye physically reacting to light and colour; this is what the sensation of sight entails. How then, for example, does one know something is three-dimensional? What are the clues, or what is

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10 Gombrich, Op.cit., p. 320.
11 Gombrich, op.cit., p. 14.

the training, which enables someone to know that a cube goes back into space, has a sense of depth and does not just consist of longer and shorter sides of a graphic shape on a two-dimensional plane? We "see" the cube yet we visually "sense" its dimensionality; tactile sensations and visual experience have taught us that a cube has depth. Most of the theories in the mid-nineteenth century became quite good at distinguishing between seeing and sensation, in fact, "...the distinction between what came to be known as 'sensation'--the mere registering of 'stimuli'--and the mental act of perception based, as Helmholtz put it, on 'unconscious inference' was a commonplace of nineteenth-century psychology".[12]

Seurat was just nineteen years old when he saw his first exhibition of Impressionist paintings; this was in 1878 and was the 4th show that the group had organized. Seurat already had three years of a classical art school background behind him before he enrolled in the École des Beaux-Arts and received an education which continued to emphasize the classics as espoused by Ingres and Poussin. While he was there, Seurat studied under Henri Lehmann, who was one of Ingres' best pupils and who, himself, commanded a certain amount of respect.[13] Seurat became good friends with two other students in Lehmann's studio, Edmond Aman-Jean and Ernest Laurent; eventually the three set out on new tangents when the training at the school became too stifling and constricting for their tastes[14].

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12 Gombrich, Op.cit., p. 15.
13 Robert Rey, La Renaissance du sentiment classique, Paris, 1931, p. 97.
14 William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 15.

Romanticism and Impressionism were influences at the start of Seurat's career; he began work under the presiding view of a very objective attitude towards nature, before he began systematizing the practices of the Impressionists.[15] It was during the two years that Seurat was studying under the Beaux-arts tradition--and during the year he volunteered in the army--that he became interested in, and acquainted with, scientific articles. It is from this point onwards, that the development of Seurat as an artist of his time as well as a master synthesizer of various new developments, begins.

It is known that the works of Delacroix had a great influence on Seurat. Although Delacroix had been elected to the Academy in 1857, his works were still rejected by the Academic establishment for being "too emotional" and his techniques were regarded as too uncontrolled; it was not until Delacroix undertook his epic paintings of 1861 that his techniques of large areas of colour depicted with separate brushstrokes were regarded as beneficial.[16] Seurat is known to have studied Delacroix's 'frescoes' in the Chapelle de Saints-Anges at Saint-Sulpice in Paris as well as other Delacroix paintings in the Louvre since some of the notes he made on these works still survive.[17] Seurat's in-depth study of Delacroix's writings and works was evidenced by his occasional comments, both written and verbal, expressing considerable admiration for and understanding of Delacroix's colour skills.

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[15] Dorra and Rewald, "The evolution of Seurat's style", Seurat: L'ouvre peint: biographie et cataloque critique, Paris, 1959, p. LXXIX.
[16] John Rewald, The History of Impressionism, 4th ed., revised, London, 1973, p. 8-24.
[17] Homer, Op.cit., p. 15; New York, 1991, pp. 394-395.

Seurat began to experiment with various black and white drawing styles which made use of his vast skills as a draughtsman and showed just how far he was willing to go to break free from the style dictates of the past. Although Seurat's classical skills were superb, he began to formulate a new style by simplifying the outlines and flattening the basic geometric shapes of the subjects he drew. It was during this time that he became acquainted with the writings of David Sutter and read his articles on 'Les Phénomenes de la Vision' in L'Art.[18]

Sutter believed that colour and line bore an intrinsic and symbolic meaning and "..maintained that there was link between philosophy and art because the former discipline is the science of man considered in relation to the ensemble of his faculties."[19] Sutter's writings, in conjunction with those of writings of Blanc, which may have been the origin for some of Sutter's ideas, greatly influenced Seurat; their "rules of order, their doctrine of essential form, their anti-naturalism and their insistence upon the permanence of form, became the geometric structure of Seurat's art."[20]

Seurat's style developed during a time when the world was changing due to the advances of science. The Neo-Impressionists were trying to "improve" upon the Impressionist tenets by making full use of this science and any structure it may have afforded them. Furthermore, in addition to the basic struggles faced by any new movement trying to gain recognition and support, both the Impressionists and the Neo-Impressionists were faced with great

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[18] Jean Sutter, Editor, The Neo-Impressionists, London, 1970, p. 13.
[19] Barbara M. Stafford, Symbol and Myth: Humbert de Superville's Essay on Absolute Signs in Art, London, 1979, p. 181.
[20] Herbert, "Seurat's Theories", 1970, p. 39. The works of Blanc will be discussed in greater detail in the sections to follow.

changes within the art world regarding their exhibition venues. Though the Salon still maintained its prestige and power, its restrictions and strict adherence to tradition had forced the Impressionists to seek new venues. Now, there were subdivisions forming within the Impressionist avant-garde which were beginning to make a bid for ultimate recognition and which would force more changes in the world of art.

Dissatisfaction from artists within the protective confines of the Salon as well as from artists trying to gain entry into the Salon had been growing and spreading until, in 1882, a splinter group broke off and held two shows for themselves, before reorganizing two years later under the name The Groupe des Artistes Indépendants.[21] The Groupe was ill-organized at first, and threatened to fall into dissolution at their very first show on 15 May 1884; only the last-minute reorganization efforts of Dubois-Pillet saved them from certain failure.[22]

In 1883, Seurat's first painting in the Salon des Artistes Français signified his entrance to and acceptance into the world of French painters; although his piece received no prize it did garner critical acclaim.[23] This event represented Seurat's initiation into the French art world and, indeed, was a necessary step in order for him to continue towards becoming a successful artist; however, it arrived at a time when traditions were about to be radically changed.

Seurat's Une Baignade, which had been rejected by the Salon, was accepted by this new group which, under Dubois-Pillet's direction, had been reorganized under the new name of the Société

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21 Jean Sutter, The Neo-Impressionists, London, 1970, p. 14.
22 Sutter, Op.cit., p. 213.
23 Sutter, Op.cit., p. 14.

des Artistes Indépendants.[24] This exhibition occurred in 1882, just eight years after the first Impressionist exhibit. Even though Seurat and his followers were considered New Impressionists, only a small span of time in the Impressionist movement actually predated the Neo-Impressionist one. The considerable amount of time in which the two groups overlapped in their development continued to be one fraught with challenges.

The Société was "...an artists' collective, with annual dues, a triennial share-out, and an ideally democratic constitution. Its basic idea was to break the power of the State, on the one hand, and of the dealers on the other, and to give the artist more of a say in his own destiny. Dear as all this was to the founders, it was no guarantee of practical success.."[25] The Société was formally founded on 4 June 1884 and, though it was thought The Groupe would dissolve in the face of the seemingly stronger and better organized Société, The Groupe proved more resilient than ever and a three year battle for ultimate control over the Paris art world began.

Competition and hostilities between The Groupe and The Société flared, each group tried to win new adherents as it strove to be the most desired organization. The Groupe held an incredibly successful show in the Tuileries on 1 May 1885, exhibited 511 works and extended the show dates by popular demand, the Société, not to be outdone, began organizing formal dinners and inviting influential Council members in an attempt to wrest greater political support from their opponents.[26] Bitter feelings escalated to the point of attacks on the personal

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24 Sutter, Op.cit., p. 16.
25 John Russell, Seurat, London, 1965, p. 170.
26 Sutter, Op.cit., p. 214.

integrity of each chairman, and letters and accusations flew in circulars and general publications, until the autumn of 1886 when Dubois-Pillet managed to win the support of the press and the public; this helped to make the Société's exhibition a financial success while the Groupe's was not.[27] This climactic autumn exhibition finally ended the duel between the two organizations and The Groupe quietly dissolved while the Société went from strength to strength, becoming so firmly established within the Parisian art world that it still exists today.

While support for Neo-Impressionism had been slowly developing in France, in other countries the support seemed stronger, more confident, and more willingly given. Seurat was invited to the Les Vingt exhibit in Brussels in 1886 and agreed to provide La Grande Jatte for their next exhibit in 1887.[28] In fact, he exhibited seven pieces at that show and, though La Grande Jatte was controversial, many Belgian painters were converted to the movement based upon the impact of that canvas alone. Thus the support in foreign countries for this new style became firmly established while in France the support was still tentative; it took until the spring of 1888, after the March Société exhibit which included Les Poseuses and Parade de Cirque, for the support for and acceptance of Neo-Impressionism to become a reality.

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[27] Sutter, Op.cit., p. 214-215. The 1886 exhibition of the Groupe included only Pissarro and Gauguin of the original membership. An incident involving Seurat in the studio of Signac, during the summer of that year, indicated just how unstable the Groupe had become. Seurat found Gauguin in Signac's studio and, not knowing he had permission to be there, summarily ordered him out. This personal ruction foreshadowed the larger splits waiting to happen within the French avant-garde as Gauguin sided with The Groupe while Seurat remained a supporter of The Société for life. (Source: House, 1991 lecture)

[28] See Appendix A.

Seurat's Drawings:
Foreshadowing Optical Considerations

It was briefly mentioned in the preceeding section that Seurat developed a unique drawing style and I believe that there is a greater connection between Seurat's drawing and his painterly styles than has been thought or recognized previously. There are certain techniques which Seurat experimented with in the the drawings which he later upgraded and used in his paintings. Only an in-depth, concentrated study of Seurat's drawings in New York in 1991 brought this out for me. Being able to see the collection together, in an intelligible arrangement, greatly facilitated this discovery. In order to show this connection in the best possible way, a full discussion on Seurat's drawing style and its development will precede further discussion on the colour style.

Seurat's drawings have never been fully integrated within his theory which has always focussed more on his colour studies and major paintings. Yet, the actual means of applying materials and how the image is built up optically, is common to both the drawings and the paintings. It could well be that, since the exhibits in Paris and New York were the only times that such a massive collection of Seurats was under one roof, no one has previously been able to pick up on the common thread of techniques and applications which ran throughout his works from his drawing stages to his paintings and from his early career to the end of his life.

Seurat's drawings, from his earlier styles through to the development of his later specialized techniques, are wonderfully accomplished. His earlier drawings exhibit a heightened sense of

contours even though there was a tendency in French art to include internal modelling which reduced the impact of the contours. Seurat's earlier drawings, however, are done simply; there is nothing extraneous or harsh. There is a minimum of internal work and the emphasis remains on the heavy contours. Although his earliest drawings are still classical and remain conventional in the Beaux-Arts style, it soon becomes apparent that his incredible skills as a draughtsman, combined with his curiosity at experimenting with techniques and papers, served to foreshadow some of his later and more widely recognized techniques with coloured oil paints on canvas.

During 1880 and 1881, just after Seurat's return to Paris from his army service, Seurat changed his drawing style several times in a quite radical manner. Laurent recalls that he and Seurat used to draw by lamplight in the early 1880s, this probably helped contribute to Seurat's ability to quickly appraise a scene and then capture its essentials on paper.[1] While Seurat had been in the army he had kept sketchbooks, and the drawings done at that time show an economy of style, with quick, vigorous strokes defining the essence of the subject. This change is logical when one considers that Seurat's time was no longer his own and any chance to draw would have been brief and precious; he no longer had the freedom to spend hours upon one drawing, his models would not have been posed and his style had to be adjusted to suit the circumstances.

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[1] Thomson, Seurat, Oxford, 1985, p. 28. (Original reference from Jamot, P. "Artistes Contemporains, Ernest Laurent", Gazette des Beaux-Arts, per 4., vol. 50, Mar 1911, p. 177) In England in the 17th C, it was the prescribed practice to use lamps to control the shadows which came in from the paper-covered windows; by the 19th C. natural light was the preferred style. One presumes certain similarities with studio practice in France.

For a brief time upon his return to Paris, his drawings were completed using long, diagonal strokes which gave a geometrical solidity to the forms; the strength of his strokes seemed to make the forms rise up toward the viewer. Femme sur un banc (1880-1881) is a prime example of this technique and more controlled than Couseuse which was done in the same style.[2] Although the figure is outlined in quick, rough and broken lines, the diagonal hatching is the drawing's primary attraction. Seurat was able to indicate form and changes in depth simply by employing heavier or thinner strokes as needed. All of the lines in the figure move from the lower left to the upper right yet we still know, without a doubt, where the woman's legs are placed under her floor-length skirt and how she sits.

His style of using diagonal strokes did not last long and Seurat soon returned to an examination of different techniques to depict changes in form. He seemed to develop two particular drawing styles by 1881: one involved nothing but scribbly lines where the conté swirled all over in varying states of compactness to indicate forms; and, the other involved a deep, dark conté crayon application whose tone was varied enough to indicate form but without the usual reliance upon contours[3]. This later drawing style of Seurat's evolved out of the more traditional Beaux-Arts style and eventually developed a life of its own as the contours slowly vanished until lines ceased to exist altogether.

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[2] See Illustration 17 for both drawings.

[3] The strokes I refer to as "scribbly lines", Homer calls balayé (Seurat and the Science of Painting, Cambridge, 1964, p. 103). He describes them as "..the long interwoven cross-hatchings, which are conducive to the optical mixture of values..." Though I agree with Homer that Seurat had an excellent foundation in values, and studied most effects of contrast in black and white before attempting them in colour, I would not call these strokes balayé. To my mind, balayé are rough, short and choppy; these strokes are soft, flowing and gently curling. I'll stick with my term "scribbly lines"!

The first technique, involving the rounded scribbly lines drawn with the end of a conté crayon, was usually done on a white paper; four drawings seem to have been done by quartering a larger sheet. Seurat's use of these scribbly lines varied from quite heavy lines like uncurled rolls of wire to very light and delicate curly filaments more like angel's hair. The curling strokes, whether heavy or light, seem to invite the viewer to experience the air surrounding the subjects. One can sense the motion in the space from the subject; even if it is just breathing, the feel of activity is always present. This is a definite precursor to the painting technique Seurat used in Jeune femme where he manually painted in the swirling particles of powder around the model.

An excellent example of this first technique can be seen in Casseur de pierres, Le Raincy (1879-1881).[4] This drawing of stonebreakers at work shows three figures engaged in various tasks, none related to the others, in front of buildings which march across the horizon and completely block our view of anything behind them. Though the buildings may have been blocked in with hatch-marks, this is difficult to notice.[5] The most dominant impression is of swirling, curling lines which weave together to form the fabric of the entire scene; dark areas are comprised of more compressed and heavier curls while the open sky is comprised of lighter curls and is far less compressed.

The subject matter that Seurat depicted came from everyday life. He presented what he saw in order that the common man

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[4] See Illustration 18.

[5] Herbert, Georges Seurat, 1991, p. 27. Herbert states that the shapes were built up with careful hatching but the overall impression is one of curly filaments going over and through everything. The hatching, to whatever extent, just looks like the texture of the paper since it is so inter-woven with the curlier strokes.

could understand what he saw; in working thusly, Seurat also included things which other artists might have excluded for aesthetic reasons: factories, buildings, bridges and other signs of industry and suburban sprawl. "These drawings were immediate responses to things Seurat actually saw. In addition to internal evidence, we have another indication that they were drawn in front of the motifs; the absence of studies for them."[6]

Perhaps in an effort to combine styles, some of the subjects Seurat drew during this time were blocked in with the diagonal hatching strokes while the curlier strokes defined the background and gave atmosphere to the piece. Silhouette de femme; La dame joufflue (1882-1884) illustrates this combination of styles.[7] The figure is composed primarily of flat grays which have been accentuated with directional hatching to enhance its three-dimensionality. Dark shadows show back-and-forth hatching at the bottom of the coat, while the hat and arms are outlined with slightly mis-aligned segments of line which meld into the gray. The figure stands in mid-step, set in a nebulous fog created by swirling and curling lighter wisps of crayon. The shapes and style are most definitely Seurat's, and no one else's, as presented in the way "..their stately, simple shapes arise from an interlace of light and dark from which they cannot be separated."[8] There are some rubbed-out lines on the left hand side of the drawing which may serve as a visual blockade to hold the drawing in on that side. This drawing shows an effective combination of styles and techniques and serves as an appropriate

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[6] Herbert, Georges Seurat, p. 34.
[7] See Illustration 19.
[8] Herbert, Georges Seurat, 1991. p. 35.

visual illustration of the development of Seurat's theory for drawing.

The second technique with which Seurat experimented still involved conté crayon in most cases since only a few drawings were created in graphite. For this technique, Seurat seemed to prefer a light red ground paper; each sheet was complete, and not cut into quarters, as the ragged and pressed edges on all four sides attest. Works done in this style show a delicate handling of shapes and an increasing softening of the contours which Seurat managed by using the side of the conté rather than the tip; the depiction of definite lines becomes virtually non-existent after Seurat had worked with this approach for a year or so. Seurat varied the tone by changing the pressure of the conté crayon, and his fondness for dragging the conté crayon along the paper just heavily enough to catch the top tufts of the paper seems to foretell of his endless curiosity about the play of light through the colours of a surface. This, combined with his beautifully unique and softly blurred drawings, which are exquisite while being strong and delicate simultaneously, also foreshadow some of his later painting styles.

A perfect example of Seurat's second technique is found in Mme. Seurat mere, (1882-1883).[9] Seurat did not supply the details in drawings done with this technique: he "...deliberately refrained from giving his figures the details that would specifiy individuality, and he did not create tangible settings. We must therefore give our attention to the shapes that he condensed into archtypes."[10] If it were not for the title, we could not guess,

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[9] See Illustration 20.

[10] Herbert, Georges Seurat, 1991, p. 36. Thomson, (Op.cit., p. 114.) mentions Seurat's deliberate omission of details in LGJ; although in colour,

specifically, who this woman was beyond that of a motherly figure. Stylistically, this drawing of the artist's mother reveals no filaments and no lines and, although the figure's head and its features are clearly "there", there are no contours. The fact that he could so unambiguously achieve a figure of such substance and dignity, while employing such a novel technique to perfection, shows us that within simplicity lies the sublime. He has captured the essence of his subject and presented it in a magical manner of which few can escape the spell's influence.

Some scholars regard the year from 1881 to 1882 as the time when Seurat's mature drawing style was established, yet Seurat seemed to vascillate in his preference between the two.[11] It was not until the end of 1882 that he began, occasionally, to combine his scribbly conté technique with his soft, contourless conté technique and Le dîneur(1883-84) is a good example.[12] The curlier strokes suggest coutours while the broadside-of-the-crayon technique gives the figure its weight. Strangely, although the figure is handled much as Mme. Seurat, the drawing fails to evoke any tenderness or nostalgia even though the model was Seurat's father. Regardless of the subject matter, Seurat now seemed able to draw upon the best techniques for all components of a drawing as his style began to coalesce into a more unified whole.

In a few cases, Seurat seemed to have used his second technique on the white paper which he usually used for the first technique. When this happened, the greater force which he used to achieve his stronger blacks caused the crayon to become too

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the technique still shows Seurat's stress on tonal rather than linear aspects.

[11] Thomson, Op.cit., p. 23. Also chronicled in Herbert's, Seurat's Drawings, New York, 1962.

[12] See Illustration 21.

embedded on the paper's surface. To me, it seemed as if the white paper had a smoother surface and less tooth. When Seurat pressed down too hard on this paper, he then had to "lift" out the blacks manually to adjust the overall tone. The effect of his removing some of the dark area produced a silvery-grey, smoky and smudgy smear within a solid black area and, sometimes, his removal efforts roughened up the surface of the paper as well. Seurat could achieve lighter tones in this way but a residual smear from the oil of the crayon was always apparent.

Le badigeonneur, (1883-1884) is an instance of where Seurat changed the tonal layout of a section in the drawing before completing a work.[13] The housepainter, done in soft, blended grays and blacks, stands leaning up on a ladder composed of diagonal lines and works against a house which is covered with scratchy, black cross-hatching. The door to the right is composed of primarily dark, vertical lines but the rest of the drawing has quick, back-and-forth hatching which "fills-in" the non-descript surface of the building. The part where Seurat may have decided that there was too much hatching runs along the left side of the paper where he has taken an eraser and rubbed across the whole mass of lines. The erasure marks are smeary and lighter and help to break up the overwhelming force of the dark lines. One gets the impression that the drawing was done quickly to achieve certain effects and once Seurat had reached his goal, he had no need to continue with the drawing process.

Herbert argues that the hatching running parallel to the hypotenuse of the three dark corners was done to fence the drawing in and indicates Seurat's consciousness of the

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[13] See Illustration 22.

rectangular composition.[14] I think that he's reading far too much into this and a simple experiment proves my point. Ask anyone to fill in a corner with a pencil or pen and they will inevitably draw across the corner rather than make parallel marks to either side of the corner; a five-year-old child will do the same knowing instinctively that angled lines "work" while vigorously drawing lines parallel to the sides will not work because the tip of the paper will be caught and perhaps torn by the crayon or pencil.

This visual effect created by rubbing-out darker areas reappeared in his later paintings when he was experimenting with different lighting effects; white grounds would be painted in first before a bluey-grey smudge appeared over it in dots; the chromatic result was the same as the achomatic effects in his rubbed out drawings (for further discussion see Parade de Cirque, chapter 5). Furthermore, some of his drawings done years later, take these effects one step further. By adding other substances, such as gouache, chalk, or watercolours, Seurat was able to get even stronger contrasts between light and dark in his drawings.

A prime example is found in Au Concert Européen (1886-1888) where Seurat has added chalk and gouache to create highlights whose brilliance surpasses that of the paper's plain and uncovered surface.[15] Although the paper has darkened with age, the effect, even in its first days, must have been startling. Seurat's conté marks work on the paper's surface and in the paper's very make-up; therefore, the addition of gouache would seem to ride above even the lightest touch of the conté creating

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[14] Herbert, Georges Seurat, 1991, p. 69.
[15] See Illustration 23.

a heightened highlight. This working at the level of the paper as well as below the paper with heavier conté and "above" the paper with super-highlights is a technique which Seurat experimented with at great lengths in his paintings; he seemed to like to indicate that the canvas really wasn't a surface or a barrier but, rather, a plane through which lights and darks passed freely.[16]

Rich feels that one of Seurat's objectives in his drawings was to "...render the sensation of volumes in space."[17] If Seurat had used lines, especially lines to define contours, the effect would have been ruined. Seurat was able to define structures in his black and white drawings and in his later paintings by a subtle blurring where contours would have been in the B/W drawings and by intermingling local and atmospheric colours around the subjects' edges in his paintings. Though he works with very different materials in his drawings and his paintings, this lack of solid contours, with no resultant loss to the sensation of substance and volume, is common to both.

One of the only areas where there seems to be little relationship between his drawing style and painting style concerns that of the graphic convention and directionality which is so evident in some of his earlier colour works. There appears to be little resemblance between his directional chromatic stroke and his achromatic drawings; even the drawings which contain

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16 This effect of passing through the canvas has been mentioned before in the context of luminosity of Seurat's paintings. Homer has addressed it in regards to La Parade, speaking of "...an undifferentiated screen that yields the desired resultant color only when one is far enough away..." (Op.cit.,p. 179). Homer does go on to say that the white patches of the La Parade canvas have the same effect on lustre found in Seurat's conté drawings, but Homer's comparision ends there. The relationship, I believe, goes much further.

17 Rich, Seurat and the evolution of "La Grande Jatte", New York, 1935, p. 20.

lines used to block in a figure exhibit little graphic convention and certainly no directionality of stroke. It is as if the visual effects Seurat could obtain without colour--the misty atmospheric constructions which still suggest great substance and solidity--needed visual encouragement in the form of graphic convention and shaping when he used colour. The natural ease with which he employed his conté crayon became forced and almost implausible at times when he picked up his brush.[18]

Conversely, one can cite a direct connection between the effects of the curly conté crayon technique in his drawings with the balayé technique in his paintings even though the techniques are quite dissimilar. I am not aware of any existing arguments as to the origin of Seurat's balayé stroke and feel that most scholars would agree that it was not a true Impressionist stroke. As discussed previously, its deliberate criss-crossed and choppy nature seems too distant from the softer and more aligned strokes preferred by the Impressionists. Although it may seem ridiculous to suggest curly conté marks are a precursor to choppy paint strokes and, technically, there is little obvious similarity; I would like to suggest that the final visual effect is what both of these techniques hold in common. Each technique plays with the atmosphere and light in such a way that the final effect is more optical than graphic; illusions suggest the contours and substance of a subject and yet never quite clearly present any

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[18] Russell, Op. cit., p. 244. Russell uses the word "implausible" in a discussion of the influence of Jules Cheret's work upon Seurat. The technique and the mood changes from achromatic to chromatic works becomes too affected for Russell to accept as a continuous and natural progression of Seurat's artistic growth. Again, I believe the relationship existed; perhaps Seurat was just undertaking too many issues then he began his colour and simply did not live long enough to work them through.

such thing. Perhaps this is yet another of Seurat's visual games, "What You Don't See, Is What You Get".

Seurat's early painting techniques:

The transition from drawing to painting

Some scholars regard Seurat's handling of his drawings and paintings to be totally separate and they feel that he treated them as two disparate aspects of his art. For example, Herbert feels that drawing with its more rational and scientific orientation had to be taught and mastered before the more "ephemeral, sensual and feminine" world of painting was entered.[1] I agree that the intricacies of drawing had to be mastered first, but I disagree when Herbert continues his argument by saying that, "Throughout his short life Seurat placed black and white before color."[2] Only if light and dark could be considered identical to "black and white" then yes, black and white comes first. However, rather than placing black and white first, per se, I feel that Seurat was always under the power of a particularly strong phenomenon which affected both his black-and-white and colour techniques: the effects of light and its absence, dark.

It is agreed that Seurat was a master of drawing; he developed his own style to depict in black and white what his keen eye saw in glorious colour. Yet, when Seurat wanted to depict his world in colour, his skills in black and white came to his aid. Thus, neither the "more rational" drawing nor the "more sensuous" painting approach was more important; they were equally valid exercises for Seurat. Without his superlative skills in drawing and his interest in employing colour to its utmost, he

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1 Herbert, Georges Seurat, 1991, p. 103.
2 Herbert, Georges Seurat, 1991, p. 103.

could not have done as well as his did in making the transition from drawing to painting.

The development of Seurat's painting style as witnessed through the changes in his brushstroke are the most obvious signs of his on-going desire to make refinements through experimentation. Any artist moving from black and white to colour has to deal with differences in media before applying them to varying supports and grounds. Changes in media handling and, perhaps, the prerequisite of a new technique are the obvious changes one encounters when moving from an achromatic to a chromatic display.

During the 1870s, the more traditional artists' paintstroke, employing lines to define structure, gave way to become more directional as Impressionists began using parallel hatched strokes to suggest shapes and contours.[3] Their brushwork slowly grew independent of form as the structure of the paintings grew around "...a build up of delicate colour values and warm-cool contrasts..."[4] which served to unify the composition even as the contours ceased to be discernable. If this description sounds strangely familiar, it could be used, with very slight variations, to describe the development of Seurat's drawing technique.

Seurat's brushstroke, however, went beyond the directional technique first used by the Impressionists. Seurat's criss-cross technique could provide for "...a systematic, scientific mode of rendering natural atmospheric light which, unlike the Impressionists, would leave nothing to chance."[5] This early

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[3] Anthea Callen, Techniques of the Impressionists, London, 1982, p. 105.
[4] Callen, Op.cit., p. 105.
[5] Callen, Op.cit., p. 106.

balayé stroke could suggest contours through a directional application yet its woven effects elicited the same subtle tonal variations which he had mastered in his drawings. The further changes from the balayé to dashes and dots may be seen simply as components in a series in his developing style; components which allowed for greater control as the system was fine-tuned.

Some scholars have felt that while Seurat worked on his canvas, he did not have to step down and back away from the canvas; lighting changes did not matter since his palette and his approach were so calculated that "Nothing was left to chance..."[6] This statement, though wonderful if anything could have been so precise, could not have been the case in reality. The pigments available to the artist in the 19th century and the technical adjustments manufactured pigments required of the artist were just two of the factors in the artistic equation which precluded a calculated and precise outcome.

Pigments available in the 19th century

There was a fairly good selection of pigments available to the artist in the early nineteenth century.[7] Although the reds available were quite limited in scope, perhaps one of the greatest advances concerned the lakes: an increased understanding of metals used in textile dyeing during the 1700's had greatly facilitated the making of the deep and richly hued lakes.[8] More stable and reliable yellows were available, although Cadmium

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[6] John Rewald, Seurat, 1990, p. 95.

[7] It should be noted that a good portion of the following has been done with English source corroboration rather than French. When I have been unable to locate specific information regarding French paint production, I have had to use information which pertained to paint production in England at the same time. However, I have, whenever, possible, tried to ascertain how similar the production methods were between the two countries and, generally, have been forced to take the stance that what one country had 'discovered', the other would not have been long in copying.

[8] Callen, Op.cit., p. 170

yellow was only available commercially after 1840 due to the scarcity of materials, and compound greens from various chromium combinations provided the bulk of "colour" beyond the earths, white and black.[9] A wide variety of blues was being produced and ultramarine blue, which had decreased in use during the 18th century but now reappeared in the 19th century, was noted for its brilliance and permanance.[10]

The 1832 prospectus of Winsor & Newton listed a handful of new synthetically produced colours which were to become the standard of colour production and remain unchanged until the 1960s: Prussian blue, Antwerp blue, Ultramarine blue, Cobalt blue, Chrome yellow, Lemon yellow and Copper green comprised the original list, with Oxide of Chromium, Cobalt green, Cadimium yellow, Cadmium red and Viridian being added in the years to come.[11]

Basically, making a pigment into an oil-based paint requires grinding the pigment and then blending in the oil-based medium. A paint medium must 1) "act as a vehicle, a fluid carrier for the pigment to be applied", and 2) "act as a binder, a matrix around the pigment particles holding them permanently in place."[12] Linseed, walnut and poppy oils have all be used with differing drying results due to the varying thicknesses of the layer of oil over the pigment; linseed oil is thicker and therefore takes longer to dry because the pigments are underneath a heavy layer

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9 Callen, Op.cit., p. 95

10 Callen, Op.cit., p. 44

11 The Artists' Colourmen's Story, Winsor & Newton catalogue, 1984, p. 24-25. This booklet was published in honour of Winsor & Newton's 150th anniversary, an exhibition "Paint and Painting" at the Tate Gallery and the opening of a permanent museum "The Artist's Colourmen's Room" at Wealdstone in 1982..

12 Paint & Painting, Exhibition catalogue, Winsor & Newton/The Tate Gallery, 1982, 78.

of oil.[13] Thus, the media binds the pigment and provides a liquid working state before the paint dries into a solid.

Manufactured paints invite new techniques

The mechanical grinding of pigments and its evolution from the 17th century to Seurat's day, is one of the factors which helped to determine some technical changes in his later works. Until the time of the mechanical production of paints, artists had been able to alter the viscosity of their paints; yet, mechanical production produced equally blended and smooth paints which reduced this variable factor.

Paint preparation had evolved from the 17th and early 18th centuries when artists' apprentices had prepared the paints for the artist, through the gradual emergence of the first artists' shops during the 18th century where individually prepared paints were available, to the domain of the artists' colourmen who had to join a guild after proving their skills as a craftsmen during the usual seven year apprenticeship and who, eventually, sold paints, supplies and acted as an advisors to the artist.[14] From the early 17th century until the mid-18th century, the colour merchants had been regarded as little more than suppliers of goods and were classfied with pharmacists and grocers; it was not until after the 1750s that the colour vendor, or colourman, emerged as a specialist in his own right.[15] The colour merchants in France seemed to have one area in which they specialized such as oil paints, or watercolours, or varnishes, while they all dealt with products of the trade such as brushes and frames; it

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13 Paint & Painting, Op.cit., p. 83.
14 The Artists' Colourmen's Story, Windsor & Newton museum catalogue, Wealdstone, 1984, p. 2.
15 Callen, Op.cit., p. 20.

was not until about 60 years later that further diversification occurred.

The colourmen's shop served both as a place of trade and the place where the freshly prepared paints were manufactured. William Reeves, whose family was the first to firmly establish the worth of the Artists' Colourman in England, became known for his innovative production of paint-cakes, the process of which was then a trade secret: after extruding the paint into lengths, these were chopped into sections, completely dried and then slightly re-wet on the outer layer so that the company's heraldic symbol could be embossed upon it.[16] Although this process pertained specifically to watercolours, oil colours were also prepared on a mass scale for the artist.

While the paint production in England seemed to be monopolized by the family businesses of Reeves and Winsor and Newton, paint production in France was more widely distributed. As stated before, if one colourman specialized in oils, another could expect custom for the especially fine quality of his varnishes, and so on. Very specialized productions of new products, like the revolutionary Conté crayon, were developed by one person and then, eventually, distributed throughout all other colour vendors' shops; in fact, the Durand-Ruel family who began as paper merchants eventually expanded to become one of the most important dealers of Impressionist paintings.[17]

As more prepared paints became available on both the English and French markets, the special status awarded the master colourman wore off. The authority given to the guilds because of

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16 The Artists' Colourmen's Story, Op.cit., p. 12.
17 Callen, Op.cit., p. 20.

their craft connotation began to decrease as the notion of "craft" now became undesirable as it carried a somewhat detrimental association due to its implications of manual and, therefore, demeaning skills. This negative shift in the status of crafts was counterbalanced by the increasing importance in the arts; with its new connotations of skill, social status and prestige, everyone, it seemed, who wanted to be anyone, picked up a brush and went to work. Now, if a colourman decided not to practice what he preached, he could serve as an advisor to one of these new practicing artists.[16] Strangely enough, although there seemed to be a wealth of "colour technicians", the preference of these amateur painters during the late 18th century was to work with the readily available materials without seeking advice about their proper application. This does not suggest, however, that all artists worked in this manner; the masters and those with substantial training continued to take advantage of the colourman's special knowledge.[19]

The tendency continued, during the end of the 18th century and into the 19th, for the majority of artists to simply, and often quite ignorantly, use their materials as they found them; many artists seemed content to leave the arduous work and technical skills of making paint to the artists' colourmen.[20] However, some nineteenth century painters had begun to approach their work with a more conscious intellectual desire to possess more knowledge about the materials they used. So, although early

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[18] Callen, Op.cit., p. 3.

[19] Callen, Op.cit., p. 3. Special mention is made of Hogarth's decision to set out his palette in a spectral order after reading Newton's Optics. Colourmen subsequently advised those who cared to inquire, that the fewest satisfactory colours of the spectrum to be used were five, the orange and indigo of Newton's colours being omitted.

[20] Paint & Painting, Op.cit., p. 40.

nineteenth century colourmen continued to provide mixed coloured pigments for most artists, they slowly began to pass on some of their knowledge via various publications which the more technically demanding artists could put to immediate use. Still, disputes often arose over the quality of the products supplied by colourmen since the artists had, over the years, lost a good degree of technical expertise and, rather than judge themselves at fault, often blamed the product or the supplier.

Until this change, the amateur artists' slap-dash application of their paints with little regard for the recommended methods and no concern for the chemistry involved was often to the detriment of the painting and certainly precluded using the material properly and to its fullest potential. The colourmen's vast experience with the chemical reactions of certain pigments, which was supported by new research from scientists, provided an even more sound basis for choosing and then applying colour systems. The industrial developments in the 1800's, the progression of scientific research and the increasing refinements of artist's supplies, made it all the more necessary for the 19th century artist to know all he could about his craft and his materials and how he might need to adjust his technique to make full use of new materials.

However, the transition from paints which were hand-made by the artist, or in the artist's studio, to paints which were made by professionals was still fraught with problems; regardless of the publications the colourmen and scientists were producing, artists continued to experience technical problems. As newer and mechanically produced paints became available in the 1880s, they often were so transformed that the artist was unable to reconcile

the differences. Since so few artists had proper training, the majority were all too easily misguided and remained confused about what they needed to achieve their goals. Less than scrupulous colour professionals further complicated the scenario by selling inferior goods: as early as 1830, J. F. L. Mérimee bemoaned that artists "no longer learning the nature of their colours were incompetent to detect fraud or to distinguish the good from the inferior sort."[21]

It has already been noted that the "advances in the scientific chemical industries at the close of the eighteenth century and throughout the nineteenth century produced an enormous expansion in the range of pigments."[22] By the mid-nineteenth century the mechanically manufactured paints offered the artist not only a greater range of colours but they were also touted to be more durable. There was an ad in 1833 in the Parisian Annual Commercial Directory for the firm of Bonnot & Cerceuil stating, "their steam-powered grinding machinery was at the disposal of customers for the grinding of all their colours and pigments"; while, just three years later, the first French colour merchant to offer mechanically ground artists' pigments for commerical sale was "Blot, in Rue St. Honoré, Paris."[23]

The primary advantage of synthetically produced colours was that they had a very even consistency; a thick, creamy pigment in one tube would be identical to a tube of the same colour purchased months, if not years, later. Before, if a pigment had been overground the resulting consistency would be pasty and if a pigment had not been ground enough, the results would be oily and

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21 Callen, Op.cit., p. 19.
22 Paint & Painting, Op.cit., p. 42.
23 Callen, Op.cit., p. 22-23.

gritty since each pigment has its own optimum level for absorbing oil. Now, though, the artist could be certain of increased control over the consistency of his paints and long-term projects would no longer be subject to the vagaries of poorly mixed paints. However, since most pigments were being ground to a similar consistency, the machine, rather than the nature of the pigment or the decision of the artist, dictated the consistency of the paint. This was one drawback from mechanical grinding of pigments which forced artists to re-learn some techniques and approaches.

Scientific research in the early nineteenth century was becoming more trustworthy as it progressed away from the vestiges of alchemy with its mystical symbols for pigments and moved toward the foundation of chemistry with its more specific nomenclature.[24] Scientists were also beginning to publish more in scientific journals detailing their research concerning pigments, the chemical composition and how they were made. Although scientists were running tests on pigments, their results were still embryonic: claims for permanence of the pigments under light, for example, were quite misleading because the tests had not been run long enough for the true lifetime of a pigment to be properly identified.[25] Therefore, although more printed scientific information concerning the composition of a pigment and its nature when combined with various binders and other pigments was

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[24] R. D. Harley, Artist's Pigments C. 1600-1835: A study in English documentary sources, London, 1970, p. 170.

[25] Harley, Op.cit., p. 172. It was not until 1892 that Winsor & Newton were able to publish a guide about the composition and permanence ratings of their colours. The publication made history since it was the first of its kind and was in direct response to angry artists who, in 1888, demanded receiving some indication about a pigment's permanence. Winsor & Newton, Op.cit., p. 1.

[25] Harley, Op.cit., p. 170.

becoming available to the artist, the artist still had to be wary, consult an accredited colourman and then selectively apply the results. And, quite obviously, if an artist did not, or could not, use a material properly, the permanence would be affected, regardless of the original degree of a pigment's reliability.

With the improvements in the mechanical production of paint arose the concommitant need for containers which would maintain the paint at the ideal consistency, prevent contamination from within or without and allow for easy and controlled usage. Bladder's from animals, pigs in particular, had been used throughout the 18th century but had a limited lifetime and were not always of the best quality. Although pre-prepared stored paints were more convenient for the artist, once the bladder had been pierced to release the paint, the quality of the paint was liable to deteriorate rapidly. Experiments were begun to find another alternative container for prepared paints.

The first metal tube was developed in England in 1822 yet it wasn't until 1841 that the first collapsible tube was marketed by John Rand: various syringe devices and stoppers were in use until 1842 when William Winsor, founder of the House of Winsor and Newton, eventually patented a screw cap.[26] Although the collapsible tube was a major breakthrough, the marketing of Rand's tubes was slow to catch on due to the confusion caused by the colourman who had first endorsed the product putting his own name, "Brown", on each tube.[27] The collapsible tubes were also slow to catch on with French painters because of the considerably

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[26] Winsor & Newton, Op.cit., p. 19.
[27] Paint & Painting, Op.cit., p.68.

higher costs of paints in tubes; it wasn't until after the mid-nineteenth century that the costs became more comparable.[28]

Although it might be tempting to cite the cause of the style changes of the Impressionists and the Neo-Impressionists as being due to the arrival of manufactured and pre-packaged paints, such a link would be tenuous at best. True, plein-air painting would be easier using such paints but having these paints was not a condition for the creation of the styles which are now recognized as Impressionistic, or even Neo-Impressionistic. There is an implication that the easier usage of tube paints carries through into "easier" styles developed by the Impressionsists and Neo-Impressionists which is simply not true; their styles are anything but simple, easy or uncomplicated.[29] In reality, the eventual increasing usage of tin tube paints had little to do with artistic styles and everything to do with cost until they became more affordable.

This chapter has looked at the art environment of 19th century France, examined the circumstances of Seurat's training including his personal touches, enumerated the special qualities of his drawing style, and has shown how his drawing techniques led to and shaped his approach to painting before any impact from the materials of his day were even considered. It remains now to look at specific examples of his early colour works before the studies to Une Baignade were undertaken in preparation for the final canvas.

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[28] Callen, Op.cit., p. 24. Callen says that in 1850 the same volume of colour cost 10 centimes more in a tube than in a bladder; by 1855 the cost was still 5 centimes higher--quite a considerable difference for a modern convenience.

[29] Anthea Callen, "Impressionistic techniques and the politics of spontaneity", Art History, 14, No.4, December 1991, p. 602.

Seurat's early colour studies, an examination

From the start of his painting career, Seurat experimented with a variety of painting styles from the more classical, such as that practiced by Ingres, through the Barbizon style before moving on to more Impressionistic styles. His colour studies from 1881 to late 1883 combined techniques from experiments in both his drawing and painting styles; the effects of value on form and his wispy strokes carried over into the paintings in a "...cross-fertilization between drawing and painting."[1] If one is familiar with the transitions in Seurat's drawing style, it is easier to see how he applied some drawing techniques directly into his paintings while others had to be altered or, eventually, removed altogether.

In Paysannes au travail, (1882-83), Seurat presents a summer's scene which, though still in an experimental stage regarding his stylistic technique, seems finished and is enjoyable as a piece on its own.[2] Herbert, though describing Seurat's colour usage in this study, states, "Like other early canvases with such large brushstrokes, it was done as a sketch or color study, not a finished picture."[3] I disagree with the end of that statement. The increasing comfort of Seurat's technique and surity of his colours is obvious in this canvas when it is compared with Le feucheur which was done just one year earlier and only hinted at the technique to come.

Though there is evidence of colour mixing from the palette and earthy tones show up in places on Paysannes au travail, the work is as complete as it can be for the stage in Seurat's career

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1 Richard Thomson, Seurat, Oxford, 1985, p. 83.
2 See Illustration 24 which also shows Le feucheur for contrast.
3 Herbert, Georges Seurat, 1991, p. 132.

in which it was done. The painting exhibits such complete reliance upon and appropriate usage of Seurat's balayé (literally: chopped straw) technique, has such a carefully constructed composition and evinces such a thorough examination of colour in light and shade, foreground and distance, that it stands on its own as a completed work. The colour theories of Rood are evident in places where green foliage abuts yellowy-orange straw and orange hats are sprinkled with dots of blue. One can feel the scratchy prickliness and hear the crunch of the hay as the women struggle to work across the field to reach the coolness of the trees and get out of the sweltering sunlight so they can open their eyes and straighten their aching backs. If that's not a complete image, I don't know what is.

When Seurat began his visual research for the setting of Une Baignade, he approached his subject in a thoroughly methodical and precise manner which is not surprising when one considers the nature of the man. Seurat studied numerous views and figure combinations while varying his lighting and colour combinations; in all, we know of 23 preparatory works undertaken for Une Baignade.[4] The lighter colours and looser brushstrokes which Seurat used in his studies for Une Baignade still follow an Impressionist manner[5]; it was not until he reworked the final canvas and began La Grande Jatte that a more Neo-Impressionistic style began to assert itself and became noticeable on its own merits.

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[4] Daniel C. Rich, Seurat and the Evolution of La Grande Jatte, New York, 1935, p. 4.
[5] Herbert, "Seurat's Theories", in Sutter's, The Neo-Impressionists, 1970, p. 28.

In the procedure which Seurat followed for his études for Une Baignade it is easy to see the direct influence of Rood[6]. Rood stressed that an artist must first master the skills of contrast in black and white before using this knowledge of values as a foundation for colour work[7]; furthermore, the procedure Seurat followed for his studies were advocated by Rood as well. After working out the colour scheme for a painting, Rood outlined the following steps for a painter: 1) first use large masses of colour while disregarding the contours; 2) then study the light and dark relationships; 3) then do several small studies executed quickly in order to capture the idea; and, 4) finally work out the chromatic effects based upon the laws of contrast in a studio setting.[8] Once these studies had been completed, they were meant to serve as handy visual references for the final piece.

The following are a selection of studies for Une Baignade which have been presented in what is thought to be their chronological order in order to better evaluate Seurat's style progression towards his final canvas. Since so many of the studies were done in the same year, for ease of reference I have presented them in the same order as they appear in the 1991 catalogue Georges Seurat: 1859-1891.[9]

L'arc-en-ciel (1883, signed lower left-hand corner "Seurat" in a style similar to the red Moline stamp), is interesting for several reasons.[10] Although the figure on the far left appears to have been posed in a studio, the rest of the composition seems to

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[6] Rood's influence will be discussed in greater detail in the next chapter in the section of Seurat's early "scientific" sources.
[7] Ogden Rood, Modern Chromatics: Student's text-book of color with applications to art and industry, New York, 1973, p. 318.
[8] Rood, Op.cit., p. 319-320.
[9] Herbert, Georges Seurat, 1991.
[10] See Illustration 25.

have been done outdoors. This joining of styles perfectly represents the transitional point that Seurat had reached by 1883: the study of a figure in a studio is a classical procedure; yet, the study of a scene in the open air, with its completion being done in a studio, was an influence of the Barbizon school.

The piece is still rough in overall technique but the increasing control and surety of Seurat's method begins to shine through in this tightly controlled composition. Signs of his haloing technique begin to become apparent; darker colours surround light figures and vice versa. The colours are rich and Seurat's use of earth tones is still evident; the whole painting is unified by these warm colours and is further enhanced by the veneer of the wood which peeks through with great regularity Allowing the wood to show through pulls the piece together and is a carryover of his more mature drawing style and as well as being anticipatory of the more complicated visual techniques in his later paintings.

A painting just done a little while later, Chevaux dans l'eau. Étude for *Une Baignade*, (c.1883-84), presents slightly different techniques than those seen in L'arc-en-ciel.[11] Thickly impasted colours cover the surface. Choppy balayé strokes are used for the grass and horizontal balayé strokes are used for the water. The horizontal stroke is reminiscent of Impressionist techniques and far too indicative of the nature of the ripples in the water to be considered even vaguely pointillistic. This study still relies heavily upon earth colours. One horse is a solid mud brown, and does not even appear to be mixed from other

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[11] See Illustration 26.

colours. The reflections in water are exaggerated in length but are indicated with strokes which more closely resemble dots than those used in the rest of the canvas. The sky is done in pastel peaches and blues, and appears overcast with a pall from the smoke from the factories. The water reflects peach from sky in a broken technique which appears to anticipate the stipple effect.

The colour combinations on this board begin to show Seurat's use of complementary colours; peach-orange against blue being the most used combination. Wherever these colours are used, part, or all, of the figure sits near something depicted in its complementary colour in order to intensify the colours. Furthermore, when Seurat wishes to increase the contrast between these two colours, he is sure to juxtapose them immediately adjacent to each other; where the peachy-orange colour meets the background, the background will be done, faintly, in blue.

Viewing this piece from a distance of about five feet helps to merge some of the colours together which could be an example of some sort of optical mixing; however, in all likelihood, this blending is due to the local colour remaining predominant and the stippling colours on top just losing some of their effect.

The brushwork in Le cheval noir (1883, Moline stamp lower left-hand corner, "Seurat") is larger and looser than that seen in L'arc-en-ciel but this may be due to the simple fact that the figures are closer to the viewer.[12],[13] Furthermore, even though the brushwork is loose each stroke is exactly where it should be. Squinting one's eyes while viewing this scene rewards the viewer with a quite believable three-dimensional depiction of a scene on

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[12] This "stamp" looks identical, to my untrained eye, to the "signature" in the lower left-hand corner of the panel L'arc-en-ciel. Which one is the stamp and which one is the painted signature?

[13] See Illustration 2.

a hot summer's day; although the contours shimmer and waver with the heat, there is no ambiguity in the presented figures.

Herbert and I are in accordance with the thought that although studies are usually perceived as workable assignments and are, therefore, considered as segments of a larger piece, in Seurat's case, these "studies" are complete unto themselves.[14] Furthermore, certain aspects of these smaller works appear almost unaltered in the final large canvas; the figures which remain virtually unchanged in this canvas are the seated figure and the reclining figure in the distance.

Seurat's Vêtements sur l'herbe (1883), was painted using the three main types of brushstrokes which appeared in the final canvas.[15] Basically, these are: 1) broad and wide, 2) balayé and, 3) long, thin and parallel. The first type was used for clothing and flesh since large flat areas could be quickly brushed in; Seurat manages to indicate the clothing in this study with little more than a dozen strokes. The balayé is the second type of stroke and Seurat has given free rein to this stroke in the grass and areas of the river bank, which, since balayé translates as "chopped hay" seems quite appropos. Thus, although the first stroke would allow for some optical mixing to occur--since the interstices of the canvas would not be filled in and further additions of colour "spots" on top would then blend with the canvas, the broad underlying stroke and any adjacent spots--optical mixing with the second balayé stroke was, perhaps, slightly better since the strokes overlapped everything and didn't stop to define contours. However, with both of these

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[14] Herbert, Georges Seurat, 1991, p. 156. These works are so "finished" that it would be difficult to consider them mere études. See discussion in Chapter One under aspects to be examined, "Études or Not?".

[15] See Illustraiton 27.

strokes, any optical mixing which occurred would still be due to the base, or ground, colour rather than any painstakingly laid out series of strokes on top.

The third stroke, the parallel long stroke, is apparent in this study and the directionality of the paintstrokes, which becomes quite forceful in La Grande Jatte, is clearly visible in the surface of the water. The long horizontal strokes, which are a direct stylistic influence from the Impressionists, are combined with the careful use of colour to give the impression of an almost glassily smooth surface reflecting the factories and riverbank behind. These long, thin strokes, which Seurat especially liked to use for water, are the least conducive to any sort of optical mixture; though many colours may be introduced into a small area, stubbornly, they remain parallel and separate.

While there are no main figures in this piece, the colour work continues to be studied and refined with more complementary colour contrasts being employed than in previous canvasses.

Figures are the main subjects in the next study Baigneur nu (1883) and the first impression is that the entire scene has been projected onto a very rough movie screen; the colours change at each contour while the texture "runs through" the contours.[16] This is due, in part, to the incredibly tight brushwork which suggests the entire piece may have been worked in the studio. Seurat's colour work continues in this piece; his "haloing" of figures involves more complex colour contrasts, and complementary colour pairs can be found on and around just about every figure. The main figures establish themselves as they will be presented in the final canvas. This is the first étude which has the sense

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16 See Illustration 12.

that the colours and the figures are working out the way Seurat had intended.[17] I find that the tightly controlled yet incredibly vigorous brushstrokes on this canvas to be far more interesting than those used in the final canvas; even the colour interplay has more vibrancy and life than the final version which appears too "chalky" and flat for my preferences.[18]

The Final study of the *Bather at Asnieres*, (1883, signed lower right: Seurat) is most definitely a study although it was done as if every stroke were pre-determined as to its location and style of application; which, indeed, with the careful and numerous studies Seurat had done, could have been the case.[19]

The reclining figure is composed of very large balayé strokes. The paint is creamy and thickly applied. The strokes most definitely show direction and define contours, changing size and direction as needed to define each figure. The colours are bold and fresh. The warm colours scattered throughout serve to exaggerate and highlight the coolness of the water; furthermore, those forms in the direct sunlight are orangy-yellow while their shaded sides are tinged with blues and violets. This light-shadow relationship was recommended by Chevreul, Blanc, and Rood as well as being practiced by some of the Impressionists.[20]

As with some of the previous studies for Une Baignade, this one shows completed versions of various poses for figures and Herbert had suggested that Seurat worked from more than one study

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17 Thomson, Op.cit., p. 48.

18 See the discussion in Chapter One on "Études or Not?" where the vitality of some of Seurat's études is examined next to the final canvasses for which the studies were done.

19 See Illustration 28.

20 For example, Chevreul, The principles of harmony and contrast of colors, English trans. from 1939 French original, London, 1872, p. 427, says that shadows should be the complementary of the light; thus, a light dominated by orange requires as complements blues and blue-violets. Again, detailed discussions on all of these theories may be found in the next chapter.

as he laid out his final canvas.[21] None of his études were rough or quick studies; all were well thought out and polished, as each systematically studied various components of the final piece.

One of the most frequently voiced criticisms of Seurat's art concerns the quality of the coloured pigments. The colours in some studies and, indeed, in some of his larger canvasses such as La Grande Jatte, were noticed to have changed quite dramatically just a short while after they were completed. Apparently, chemical changes within the paint mixtures as well as Seurat's experimenting with different grounds and surfaces added to this problem. However, in all of the studies cited above for Une Baignade, none of the colours seemed unduly faded or gray. Of course, time will dull the colours, but all of the colours in the Une Baignade studies were still discernable as a pale pink versus a lilac tone versus an orange tone, and so forth. Russell mentions that some of Seurat's final canvasses are so dulled and dirty and have become so much "..grayer and grayer..." that comparison of Seurat's works at this time to those of other artists can only be done on the basis of the monumental architectural structures, with the aspect of colour being relegated to last place.[22] Although no one alive today has had the experience of seeing a Seurat freshly finished, I think statements such as that may be going too far. We can certainly review Seurat's colour studies and even his final canvasses as long as we keep our judgements within the boundaries defined by the conditions within and the materials with which he worked.

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21 Herbert, Georges Seurat 1991, p. 161.
22 Russell, Seurat, London, 1965, p. 264-266.

Une Baignade, a personal viewing

The brief descriptions of some of the études done for Une Baignade provided some indication as to the theoretical and pictorial sources Seurat used for his first large canvas. The final work was a synthesis from those theoretical and stylistic origins and, for a young painter trying to combine so many different influencing aspects into a cohesive whole, it was a very successful attempt. Seurat's concerns with the "...light-shadow relationships, gradation, contrast, the system of color harmony, pigments, and procedure and method" were attempted and dealt with in a a more competent manner than painters who were far more experienced.[1]

Bathers at Asnieres, Seurat's first major canvas, was painted in 1883-84 and resides now at the National Gallery, Trafalgar Square, London.[2] There is a huge painted signature in the lower left-hand side employing the colours of blue, green and lavender. The overall effect of the canvas is of something drawn in dry chalk rather than painted in oils. The colours are in pastel shades and are quite faded and lightly applied. There is some effect of optical mixture in places where there is "..dragged, chalky paint catching on...earlier dried brushstrokes" which allows the first colour to show through the second.[3] Choppy wisps of colour are laid over the ground colours of most of the subjects depicted.

The figures are handled classically, monumentally. Their poses are measured, the presentation and modelling of their

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[1] William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 55.
[2] See Illustration 31.
[3] Anthea Callen, Techniques of the Impressionists, London, 1982, p. 113.

surfaces' is conventional. This is a direct influence from Puvis whose drawings also had stronger contours than the norm at the time; even though there was some internal modelling, the flattening out of the figures and the simplification of forms hinted at greater design interests than realistic depictions.

The main strokes which are visible--many have faded away or were too blended or lightly applied originally to be easily seen--are wispy balayé-sort of strokes. The balayé is not directional and the individual strokes overlap one another gently and loosely. The balayé is not as choppy as some of Seurat's earlier studies but, instead, curves gracefully and suggests a gentle rhythm which carries across the canvas. There is a very organic and freely flowing feel to the strokes where they are visible. For example, some of the strokes in the grass look like this:

which is quite a change from from the rough, chopped balayé of his earlier studies.

There are a few areas where tiny and quite distinct colour spots appear which are extremely unexpected when compared to the style of the painting as a whole. The hat on the figure in the water and slightly to the left of the hat is sprinkled with small dots of orange and yellow-gold which are shaped liked this: [4] Yellow-gold spots reappear to the left of the other figure in the water in the floating vegetation. Green spots rediate out from the hat in the grass and follow the contours of the clothes, they

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[4] See Illustration 30.

also carry on above the shadow cast by the main seated figure's head. These areas of tiny spots are, in fact, the areas which Seurat reworked, as Homer has mentioned in a direct quote from Signac.[5] No other areas on the canvas have spots of this size.

The one distinct area of directional strokes is in the red hat worn by one of the figures in the water.[6] The band and the brim are depicted by red spots which tightly follow the contours of the hat. This directionality of stroke is used intensely in La Grande Jatte and will be examined further in the next chapter.

There is a great reliance on lavender and blues in the shadows which harmonizes with the use of oranges and yellows in the sunlit areas and this is one of the three main sets of colours Seurat used to harmonize the canvas. The three types of colour harmonies were achieved via the following approaches: 1) a triad of colours residing 120 degrees apart on the colour contrast diagram employs ultramarine blue and blues to yellow-green and greens to purples and yellow oranges; 2) pairs of complementaries are employed to contrast each other as per Chevreul's ideas, and; 3) analogous colours such as reddish-orange or yellow-orange are placed next to each other for greater harmony.[7] This last analogous colour harmony occurs all over every area of the canvas and, because of the close relationships of some of the colours--there is such a small interval separating them from one another on the contrast diagram--Seurat has, in effect, used gradation to enhance the canvas.

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[5] Signac, "Journal inédit de Paul Signac, I. 1894-1895". Gazette des beaux-arts, XXXVI, July-September, 1949, p. 114.

[6] See Illustration 32.

[7] Homer, Op.cit., p. 93

Outlines are visible on the factory chimneys, around the pillow underneath the seated figure, in the hat on the grass, through the clothes on the grass, and are used to depict the buildings and walls and on the people in the water. The reclining figure's feet and the figures in the water also begin to indicate some play with complementary colours and the halo effect begins to become noticeable. This use of hue contrast, from complementary colours surrounding the local colour in the form of haloing, helps to harmonize the overall colour relationship as well as intensifying the nearby complementaries.

Seurat understood the laws of contrast quite well and applied them correctly in Une Baignade but his continuing use of earth colours tended to "pull down" the final effect.[8] The studies and croquetons, which had been executed in prismatic colours, retained a freshness and vitality which was lost to some extent in the final canvas when he used earth colours and black.

Deep and jagged cracks have appeared in the flesh-tone areas, in the clothes on the ground, in the white coat of the reclining figure and on the sailboat; this supports the description of Seurat's application of paint where he was supposed to apply heavy and broad strokes of paint for the flesh and clothing. The craquelure also occurs in the lighter areas of the canvas but not in the darker areas which were done in a thinner and more scrumbled technique to allow some of the base colours to show through.

The meaning of the subject matter remains a matter of speculation. Some scholars feel that Une Baignade is a "profound

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[8] Rewald, Seurat: A biography, 1990, p. 58.

comment upon modern industrial society."[9] Seurat's depiction of the working class relaxing and enjoying the pleasures of bathing might seem to be an endorsement of socialist interests yet his lack of writings or comments confirming or denying such possibilities must make us cautious in our judgements. As Homer states, "...Seurat seems to have wanted to combine Puvis' sense of decorative design with a modern divisionist approach and contemporary subject matter--all of which was governed by a controlled value scheme."[10] Perhaps that is as far as we can infer Seurat's intentions from this subject.

The simple fact that the industrial revolution was having such an impact upon society, affecting all the classes and causing considerable reconstruction within some, could be the reason Seurat chose to immortalize a moment in time with some of its active participants. Perhaps he was simply portraying what was in front of him and had no conscious political intentions, no one can say for certain what his reasons were for choosing this subject. Whatever his reasons for presenting us with this scene, Une Baignade maintains a classical harmony, grandeur, and equilibrium, even though it is of a modern, everyday scene in a suburb.

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[9] John Russell, Seurat, 1964, p. 123.
[10] Homer, Op.cit., p. 97.

CHAPTER THREE

Towards La Grande Jatte:

Solar Orange

A stable reality or a chemical quirk?

At this juncture it might be worth pointing out that one aspect affecting precise identification of paints has to do with the nomenclature itself. Pigment names, which are fairly standard, may, and sometimes do, differ greatly from proprietary names which are particular to the manufacturer of the paint. Inaccuracies may arise when trying to pinpoint pigment compositions with words like "mauve" which is really a dye, or "violet" which is manufactured from either manganese or cobalt and "madder lake", which implies a fairly consistent resulting colour yet can vary from manufacturer to manufacturer. If an artist copies down a formula or recipe for a suggested colour combination he may just indicate "cadmium yellow" knowing precisely what he means and what is meant by his reference but failing entirely in his citation to indicate to another person what he means more specifically. For example, Cadmium Yellow, Cadmium Yellow Light or Cadmium Yellow Medium; Cadmium Yellow Pale or Cadmium Yellow Deep; or Cadmium Yellow Hue, Cadmium Yellow Deep Hue, Cadmium Yellow Pale Hue or Cadmium Yellow Light Hue are the nine names for "cadmium yellow" oil paint colours listed in the 1892 Winsor & Newton technical information manifesto published to help artists.[1] All of those nine colours

[1] Winsor & Newton, "Notes on the Composition and Permanance of Artists' Colours" handbook, no publication date given. This is a copy of the original which was probably published in London. The statement stands

were separate and distinct in their chemical composition, yet all fell under the general heading "cadmium yellow". No wonder confusions abound!

One of the strangest and least resolved aspects of Seurat's colour choices revolves around what became termed "Solar Orange". Solar orange is a recognized colour name in the Seurat literature even though it was a particularly fugitive colour. For example, Homer quotes Fénéon explaining a technique in Seurat's method of working in which a "...portion of coloured light that is reflected unaltered from its surface (this will usually be Solar Orange)"is added;[2] Homer then mentions "Solar Orange" repeatedly discussing where it appeared in Une Baignade and La Grande Jatte and how it affects colour relationships.[3]

Yet, strangely, these writers never sought specifically to discover what "Solar Orange" really meant or what it was in the "Solar Orange" which made it disappear so quickly. The phrase "Solar Orange" seems to have become so much a part of the Seurat nomenclature that its original mystique has vanished as surely as the pigment. "What's that colour there?" "Solar Orange." "Oh, yes, fine. And over there?" No questions, no quibbles. Apparently just a common-place colour this Solar Orange.

I disagree.

Of all of the colours mentioned in Seurat's palette, there seems to be the largest discrepancy about what pigments comprised

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unchanged in every word today, as it was then, with the exception of a blurb at the beginning stating that "*Field's Chromatography* is now out of print and that the North London Colour Works have now been moved to larger and more modern premises at Wealdstone, near Harrow." The Wealdstone address is where this copy was obtained.

[2] William Homer, Seurat and the Science of Painting Cambridge, 1964, p. 132 quoting Fénéon out of his "Le Néo-impressioninnisme," L'Art moderne, May 1, 1887, p. 139.

[3] Homer, Op.cit., p. 134 and 139.

the red-to-yellow region and whether he combined a yellow with a red to get an orange or whether he used a darker version of a specific yellow for his oranges. Homer cites part of one of Signac's letters which entails a small sketch of his palette colours as being representative of Seurat's colours. The yellows and reds which Signac used are: cadmium, vermilion, madder lakes, and cadmium light.[4] Callen extends the range of Signac's spectral palette with the additions of a mid-cadmium yellow, deep cadmium yellow, alizaron crimson, and rose madder[5] but indicates subtle differences between this and Seurat's palette which lacks either the mid- or deep-cadmium yellow as well as omitting the rose madder.[6]

My concern with "Solar Orange"--what was meant by the name and what its composition could have been--was presented to a modern-day colourman in Yorkshire. J. P. Stephenson graciously offered to work on the problem I put to him and during the course of our correspondence, offered the following suggestions:

> Both Cadmium Orange and Chrome Orange were available during Seurat's lifetime. Cadmium Orange is a very reliable colour and can, therefore, be ruled out. Chrome Orange is a darker variant of Chrome Yellow but still would prove fairly reliable.
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> Two other possibilities are as follows. First, the "Solar Orange" could be a blend of a natural yellow and some red organic pigment. However, Turner used combinations such as these and his oranges have lasted reasonably well. It is known that he used a version of madder lake and quercitron, which was found in his studio, to produce a strong orange.
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> The second possibility for "Solar Orange" was that it was an early synthetic organic. Aniline dyes, which are also known as coal tars, were first produced in the 1850s. Within a short time, they earned a very poor reputation because of their

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4 Homer, Op.cit., p. 151.

5 Anthea Callen, Techniques of the Impressionists, London, 1982, p. 110.

6 Callen, Op.cit., p. 146.

> instability and reactions with other pigments. This is probably the strongest possibility for Seurat's "Solar Orange".
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> The word "solar" has an obvious reference to the sun and there were similar allusions to earlier names for some of the coal tars. Furthermore, aniline dyes were known to have vanished--even some natural organics disappear and discolour--so whether man-made or natural, aniline dyes were unstable.[7]

The alternatives for Solar Orange as listed by Mr. Stephenson involve only one real possibility. Cadmium orange, a variant of cadmium yellow, was discovered in 1817 but not manufactured until the 1840s since it proved an expensive paint to manufacture. It was very durable and quite heat resistant.[8] Chrome orange, which ranged from yellows through to reds, was precipitated from lead acetate or lead nitrate and potassium chromate and was manufactured quite inexpensively from the 1820s onwards; some discolouration was found under intensive light exposure but it was generally regarded as quite stable.[9] As Mr. Stephenson explained, his next suggestion of a blend from a natural yellow with a red organic could not be proved to be the Solar Orange Seurat used especially since similar blends used by other artists have proved to be very permanent. It is his last suggestion, the synthetic organic, which has the greatest chance of explaining Solar Orange.

The distilling of coal tar was undertaken to produce chemicals for a wide range of uses and it was not until 1856 that a discovery was made which started up a whole new industry, that of the coal tar dye industry.[10] After the distillation process,

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[7] J. P. Stephenson, Artist's Colourman, originally S. Yorks. when corresponding with me, now moved to Doncaster. The information is a composite of his answers to my questions during 1988.

[8] Paint & Painting: An exhibition and working studio, catalogue, London, 1982, p. 18.

[9] Paint & Painting, Op.cit., p. 17.

[10] Paint & Painting, Op.cit., p. 19.

another step was taken to produce more chemicals; one of these chemical intermediates is called aniline and it is this which may have had some contrary effect in what eventually became a complex organic pigment. Only the most permanent of pigments continued to be used in the dye industry; one of the most permanent of these organic pigments was produced under a name which identified its producers rather than its components since its chemical make-up was so complex.[11] Unfortunately, some unstable pigments were also manufactured and sold until their weaknesses becamse apparent and their production was stopped. One of these unstable pigments produced from the aniline dye could have contributed to the fugitive Solar Orange.

Another unstable pigment, zinc yellow, was so "shifty" that it changed not only its own colour appearance but it also affected any pigments which it touched. I wonder whether or not Seurat used zinc yellow as one of the components in his Solar Orange. It has been proven that he used zinc yellow in the second stage of La Grande Jatte, so we might surmise that he may have used it elsewhere, too.[12] Zinc yellow was notoriously unstable and tended to "pull-down" other colours with time, dulling their impact and reducing their effects. Zinc yellow is a yellow pigment using chromium; a hot solution of potassium dichromate is mixed with a solution of zinc sulphate to produce a non-toxic, deep, and bright colour which is not particularly lightfast.[13] Lightfastness is a scientific measure of a pigment's ability to retain its chromatic characteristics and is not the

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[11] Paint & Painting, Op.cit., p. 22. This set of pigments was first discovered by a German company and was named Hansa. When Winsor & Newton began to produce it, they had to use their own name "Winsor"

[12] For a complete discussion on this, see the section in this chapter entitled Seurat's Palette.

[13] Paint & Painting, Op.cit., p. 17.

same as permanence; although it is one aspect of permanence.[14] However, such speculation about the especially rapid fugitive qualities of Seurat's special "Solar Orange" was not providing specific answers, so I contacted people who could provide more technical information, the paint manufacturers themselves.

Peter Staples, who was the Technical Director at Winsor & Newton, Ltd. when I contacted him, suggested that Seurat's "Solar Orange" could have included an impermanent lake when he sent me copy of his company's 1892 manifesto.[15] It has already been mentioned that Winsor & Newton, Ltd. made history by publishing this volume in 1892 as an attempt to stem a growing dissatisfaction amongst artists. The problem at hand was described:

> Two criticisms are often levelled by thoughtless people at the heads of Artists' Colourmen, and of these we have decided, as one of the leading English firms, to take some practical notice. It is alleged: 1. The Artists' Colourmen are in the habit of selling colours which are not permanent; and 2. That they keep artists in ignorance of the chemical composition of the colours they sell.[16]

The company began to defend its practices by acknowledging that the customer had a right to any pigment which was available but must be aware that not all pigments will last forever, rather they are "..as durable as they <u>can be made</u>."[17] Furthermore, they would be perfectly willing to disclose the chemical and the technical information which the artists' seemed to require only as far as was necessary for the proper use of the material and

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[14] Winsor & Newton, "Notes...", p. 2, second column.
[15] This information was obtained from correspondence during the summer of 1987. No one within the employ of Winsor & Newton, Ltd. could identify "solar orange" without hesitation and, although they sent all the literature they had on hand, the question remained unanswered.
[16] Winsor & Newton, "Notes...", p. 1, column one.
[17] Winsor & Newton, "Notes...", p. 1, column one, my emphasis.

would "...reserve to ourselves only those details which have reference to the manner in which these pigments and mediums are made."[18] Thus, the artist could now discover for himself how permanent he might expect his colours to be and what pigments constituted the chemical make-up of his paints.

In Winsor & Newton's continuing explanation of the permanance rating of the colours, the tests employed to obtain the results, the definition of the terms under which "permanence" would be considered, and the degrees of permanence rating, lie buried two sentences which may have a bearing on the search for "Solar Orange":

> There are too, certain cases in which colours act on each other chemically when mixed together and in this category Winsor Orange Oil Colour and Scarlet Lake Oil Colour should not be used in the form of very pale tints with white. Such tints particularly when the white is Flake White, tend to fade out, even the dark.[19]

This little blurb corresponds with the suggestion made by Peter Staples that Solar Orange could have included an impermanent lake. Although we have reported that Seurat's canvas contained Zinc White, rather than Flake White, the Scarlet Lake oil colour had no rating regarding its lightfastness yet was fairly durable overall. Whether Seurat may have combined this Scarlet lake with zinc white with unexpected results, or used a Geranium lake oil which was listed as being extremely fugitive, one can only surmise.[20]

Since the Solar Orange disappeared so quickly from Seurat's canvas and there seems to be no obvious identification of a specific pigment or blend of pigments which would have been so

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18 Winsor & Newton, "Notes...", p. 1, column two.
19 Winsor & Newton, "Notes...", p. 2, column one.
20 Winsor & Newton, "Notes...", p. 8, column two.

fugitive, there may be other causes for its disappearance. If no immediately identifiable chemical instability from a pigment can be cited as the culprit, perhaps the binder used to fashion the pigment into a paint was at fault. The purpose of a binder, obviously, was to bond the individual particles of pigment together into a paint. Furthermore, it is logical to accept that pigments which require less binders, i.e., paints with less oil, will have greater permanency, will dry more quickly and will yellow less.

Linseed oil had been the oil which was most commonly used but it had a tendency to turn yellow with age. The Dutch were the first to use poppy oil during the 17th century yet it took the French another two hundred years to affirm the choice of the Dutch by making poppy oil their preferred oil; indeed, Callen quotes Vibert as saying, "today only poppy oil is used, except for a few dark colours with which the use of linseed oil is accepted."[21] Poppy oil usage became more popular since it did not turn yellow as rapidly or as drastically as linseed oil, and colours made with poppy oil were thick and creamy and retained the texture of the brushstroke, a great benefit to the Impressionists. Using poppy oil as a binder also produced paints which were slower to dry; this encouraged and facilitated wet-in-wet techniques.[22]

Yet, the prevalence of its actual use seems to be arguable however, as "the only examples of the apparent use of poppyseed oil have been in French pictures, and notably in Seurat and

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21 Callen, Op.cit., p. 23. Though her quote from Vibert is not dated, she seems convinced poppy oil was the most important binder in 19th century France.

22 Callen, Op.cit., p. 23.

Monet."[23] Curiosity was expressed by the authors of a 1972 study as to the paucity of examples of poppyseed oil usage and the suggestion was made to further investigate paints made up by 19th century French colourmen; the only specific uses of poppy oil they found were in Monet's Waterlillies of 1918 and Seurat's Une Baignade of 1883.[24] One wonders, then, who was correct: the 19th century commentators who reported what they thought was occurring or the 20th century writers who could report on only the narrow spectrum of the works that they had analyzed; each made generalizations based upon their experience yet, one group had to be incorrect.

In addition to the change of oils used as a binder in pigment production in the nineteenth century, great experimentation was being undertaken with additives in paint. As we have seen the development of mechanical grinding of pigments produced paints which were of a uniform thickness and texture; this alone brought about changes in painting techniques since layering thin glazes for dark areas was almost impossible with the newly opaque paints; painters now had to load their brushes equally for light and dark areas. In order to reinstate some variation of consistency in the paints, manufacturers began to put additives into their paints. Anything from wax, beef or mutton tallow, to sperm whale oil was added to facilitate manipulation of the paints.[25] Unfortunately, these additives

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[23] N. Brommelle and P. Smith, Eds., Conservation and restoration of pictorial art: The International Institute for Conservation of Historic and Artistic Works, London, 1976, p. 73. This citation is from a paper entitled "The Gas Chromatographic Examination of Paint Media. Some Examples of Medium Identification in Paintings by Fatty Acid Analysis" by John S. Mills and R. White. It should be noted that this book was published four years after the Congress met in Lisbon in October 1972.

[24] Brommelle and Smith, Op.cit., p. 73.

[25] Callen, Op.cit., p. 24.

often encouraged contamination of the paints even if they did provide a false economy by reducing the amounts of pigments used in the process. If Solar Orange had had such additives, the increased instability caused by them could have brought about countless outcomes.

At this point in time, I have still been unable firmly to identify the composition of Seurat's Solar Orange. If Seurat's Solar Orange had been created with zinc yellow as one of its components, it would be perfectly understandable why the surfaces of his canvasses are now covered with muddy, pumpkin-orange dots rather than the more brilliant Solar Oranges; the zinc yellow would have "pulled down" the colours it touched. If there had been some reaction between poppy oil and a delicate pigment, that could have caused the vanishing act. If an unstable analine dye had been used as part of a blend for an orange, that could have caused the evaporation of the stronger colour. If Seurat had used a combination of a impermanent pigment which further reacted with his white, that could have caused his "Solar Orange" to disappear. Seurat did not have the good fortune to be able to study anything like Winsor & Newton's manifesto, and in all likelihood, he would have fallen prey to some rather dubious colour combinations in his time. Unfortunately, without specific notation from him regarding what constituted his oranges or present-day precise chemical analysis from a "blob" which could be considered a "Solar Orange", we only can offer a series of informed possibilities rather than conclusive answers.

Towards La Grande Jatte:

Preparatory studies

People with multi-coloured fleas all over their bodies. Grass liberally daubed with orange or blue splotches. Water composed not only of yellows and greens when situated near botanical lushness but of red and oranges when near people wearing brightly coloured clothing. Is this a world gone mad or a world as seen by a lunatic with optical difficulties? The answer, of course, is that this is a world as depicted by Seurat and the world, in particular, as it existed in his painting of the Island of La Grande Jatte on a relaxed Sunday afternoon in the early 1880s.

Seurat painted numerous studies and drew several versions of the six main figures in La Grande Jatte, even though the final piece contained over 40 people in the scene.[1] There were at least 20 drawings done on site to fix the motif and another 30 oil paintings which were rapidly executed in loose brushstrokes to provide visual references before the larger studies were executed in the studio.[2] This was a far cry from what the Impressionists had been espousing; although some of Seurat's techniques were similar to those found in Impressionist works, his slow and methodical approach to the massive final canvas was anything but spontaneously impulsive. This approach to working suggests that Seurat felt a need to organize as many of the factors as he could

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[1] See Illustration 31.

[2] Herbert, Georges Seurat, 1991, p. 74. Rich, Op.cit., p. 4, claims a total of 70 preparatory works were completed for La Grande Jatte. Rey, La Renaissance du sentiment classique... Paris, 1921, p. 144 says La Grande Jatte entailed 2 years of careful preparation with 23 drawings and 38 oil sketches being produced before the larger études were done.

before beginning the final work; lines, tones, tints, landscape, figure poses and groupings were all carefully worked through.

For example, in the final stages of preparation, Seurat painted his figures more or less as he had seen them in real life but, where necessary, had models pose to re-create or slightly alter the positions.[3] Generally, the figures are strongly classical in the compositions which, as he explored them, sometimes necessitated changes in the actual landscape to keep to his strict discipline of the composition.[4] Even with all of Seurat's attention to detail, some of the figure groups are not in proportion to each other or to where they appear on the final canvas, and "Where a relationship occurs between a drawn figure and one for which there is no (existing) drawing, disjunctions crop up..."[5] Further disparities in size and placement may be due to the fact that Seurat also used characters from earlier studies in his final canvas.

One instance of an earlier figure being used in a subsequent painting can be found when one compares the main seated figure in Massive dans un Paysage `a Barbizon , an oil painting done on a wooden panel in 1882 with the main figure in Petite Equisse pour "La Grande Jatte" (1884).[6] Even though the study was painted some two years later, Seurat has used virtually the same pose of the seated figure in second study. In the this study, Seurat has sprinkled figures across the canvas in a seeming attempt to discover which sort of figure combinations worked. As in the

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[3] Rewald, Seurat: A biography, 1990, p. 77. For example, the illustrations 118 and 122 on pages 180 and 184 respectively, in Herbert's Georges Seurat: 1859-1891 depict some changes in the layout and shapes of the trees.

[4] Thomson, Seurat., Oxford, 1985., p. 98.

[5] Thomson, Op.cit., p. 112.

[6] See Illustration 32.

final canvas, this one shows enormous figures in the frontal planes of space with figures not much smaller behind them; the furthest figures are far too tiny for the distance of the scene and the proportions are distorted and skewed all over the canvas. One has the sense that he was interested in trying out positions and pictorial effect more than he was concerned with the implications of the sizes of the figures according to strict spatial scalings. Although the figures are disconcerting to look at regarding their placement and size, their colours offset each other perfectly as the cool green growth of nature supports the muted purples, oranges and reds of the figures' clothing. The final "feel" is that this study is a working canvas in which Seurat tried to incorporate new features around a successful aspect from a prior piece.[7]

As with the studies and preparatory work Seurat did for Une Baignade, the work done for La Grande Jatte looks at particular aspects of the final canvas; figures are re-arranged and re-grouped, sometimes being reversed back-to-front until he reached a pleasing composition; colour harmonies are are worked out section by section, in slightly varying lighting conditions, and with varying points of view. However, in opposition to Une Baignade, the early studies for La Grande Jatte done in 1884, involve a softening of the figures' contours; more consistent use

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[7] This is not such a strange practice and Seurat was probably making use of an approach which worked; keeping a pictorial file is common practice amongst graphic artists and fine artists certainly did the same, albeit on a smaller scale. Furthermore, this practice may have been influenced by the slight tendency for fine arts to move closer to the realm of graphic arts; although the influence of Chéret and others of his ilk on Seurat may not have been so readily apparent in the 1880s, by the 1890s there was quite a strong connection and influence of "poster-art" cannot be ignored. (See Robert Herbert, "Seurat and Jules Cherét", Art Bulletin, 40, 12, 1958.) This will become more apparent when we look at the styles of some of Seurat's later canvasses in Chapter Five.

of divisionism for areas of sunlight and shade; more practiced use of colour contrast and gradation; softer brushstrokes in general with colour intensity reducing with distance; and, a greater sense of light and atmosphere. The croquetons for La Grande Jatte may not have been executed in a strictly pointillist manner but they are done in a divisionist method and "despite the speed with which they were done, the touch is pure, the elements are balanced, and the laws of contrast are observed."[8] The studies for La Grande Jatte which were done just one year later show a greater understanding of the optical laws of contrast and complementary colours, a reduction and an elimination at times, of palette mixing, and a greater awareness of controlled, on-canvas, colour mixing through eliminating any inadvertent blends of still-wet paints.

The following selection of studies for La Grande Jatte, and a few other studies done during the same time, have been mentioned because they had such a striking visual presence that they "stood out" from the rest of the studies which I had viewed in person or because they illustrated some new technique or clearly showed a progression in Seurat's theory. I have tried to list them in a chronological order, more or less, though this does not necessarily correspond to Seurat's working order since he re-worked some of his studies as well as the final canvas.

Paysage et personnages (1883-84) is unfinished, yet it shows more complex colour theory usage than that found in Une Baignade.[9] The use of purples against areas of sunlight done in orange supports Seurat's familiarity with Rood's principles.

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[8] P. Signac, D'Eugene Delacroix au Neo-Impressionisme, as quoted by, Rewald, Seurat: A biography, 1990, p. 77. See Illustration 33.
[9] See Illustration 34.

Seurat's fondness for letting the wood show through helps to warm up and unify this otherwise cool piece. The scene is calm and quiet; long, early-morning shadows cover the peaceful area before the heat of the sun and the bustle of the crowds invade. Strangely enough, after using oranges and yellows for sunlight in this study, Seurat changes and employs white flecks in Une voile sur l'eau (1884).[10] One wonders if this represents a transitional phase before he begins to employ his "Solar Orange".

The small study for La Grande Jatte (1884, shown in Illustration 34) has already been discussed in part. This study is for the mid-left hand side of La Grande Jatte, where the orange-clothed woman is fishing in the final composition. Though it is difficult to ascertain from reproductions, this woman serves as the visual focus of this study namely due to her colour treatment. The colours used for her are mostly a burnt sienna and orange which make her stand out from the remaining figures which are shown in darker colours.

Her figure exhibits a slightly outlined effect, which is consistent with Seurat's putting a halo around key coloured figures; this serves as a preview for the finished La Grande Jatte. The strokes on her body, cross-hatch themselves to some degree yet still give an indication of direction as they define the contour. The depiction of her face and hat is extremely vague; there are no features or suggestions of them and she looks as if the dress material covers her entire form; even so, she still exhibits more detail than the other subjects which are depicted in small balayé strokes.

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[10] See Herbert, Georges Seurat: 1859-1891, p. 183, Figure 121.

Paysage, l'Ile de la Grande Jatte, (1884, signed and dated, LL, "Seurat-84") is one of the larger studies Seurat did for La Grande Jatte and one of the first which he painted on canvas.[11] Seurat's own notations and modern-day scientific tests reveal that there were three stages of paintwork in this study: the original, a retouched layer applied about 1885 when he returned from Grandcamp, and a painted border added about 1888-89.[12,13] The smooth glassy water's surface from Une Baignade reappears in this study as does his treatment of the trees which is reminiscent to that found in Sous-bois `a Pontaubert (1881). It is this treatment of the trees from that 1881 canvas which makes me wonder the extent that this part of the canvas was actually reworked. It is only the lower third of the canvas which maintains a distinct visual difference and this is due, primarily, to the addition of tiny orange dots in the shaded areas.

The colour contrast and theory work are more advanced than in previous studies, with the tiny strokes of orange spots in the shade being identical to those found in La Grande Jatte; Herbert calls these strokes "solar orange" and verifies they are found in the shade to offer a hue contrast.[14] This suggests to me that this canvas may have been intended originally as a study until

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[11] See Illustration 11.

[12] Russell, Seurat, London, 1965, p. 174. This canvas was re-worked after Seurat returned to Paris from his summer in Grandcamp. He had experimented with the divisionist technique all summer long and Pissarro's enthusiasm towards this new approach may have further prompted Seurat to follow a stricter adherence of the pointillist style.

[13] Inge Fiedler, A technical review of La Grande Jatte, The Art Institute of Chicago Museum Studies special issue catalogue, Vol. 14, No. 3, 1989, p. 173. Seurat's own testimony states that he used zinc yellow, an unstable colour which toned down colours with time, when he reworked La Grande Jatte after October 1885. Since zinc yellow was not found in the second stage of this study the reworking, such as it was, is dated prior to autumn of 1885.

[14] Herbert, Georges Seurat: 1859-1891, p. 204.

Seurat's theory became more refined and he worked on it simultaneously with La Grande Jatte. Though, considering that the "reworking" is found in select areas only, Seurat seemed to have turned his attention to the final canvas as soon as he knew what he needed to do from his efforts on this canvas.

Lastly, the border addition from 1888 is narrow and does not seem, to me, to follow the theory too well. Herbert mentions an almost solid blue border along the bottom which changes to blues and reds next to foliage before becoming a blue and orange mixture next to the sky.[15] What I saw was an extremely dry bluey-grey border with a slight mottling of contrasting border colours every now and then. Without a specific chemical analysis, I cannot be sure what pigments were used; regardless of the colours, the paints from this last application were much less oily and have not stood the test of time as well as the rest of the canvas.

The painting, Le Couple, (1884) is an unfinished piece which gives us a good indication of Seurat's working methods.[16] The first impact is "green"; the whole canvas resonates with "green". Light greens, darker greens and blue greens predominate. The next most prominent colour scheme ranges from lilacs, through scarlets and violets to blues. Seurat was blocking in the figures in a very basic colour scheme and using gradation to define the shapes. If this is how he blocked in the figures on the final canvas, it is easy to see how the colour of any figure would have been obtained more from this initial paint application stage than from an optical mixture or from the effects of

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15 Herbert, Georges Seurat: 1859-1891, p. 206.
16 See Illustration 35.

contrast. Fiedler has identified that there is one area of colour which resulted from a palette mixture; the large woman's arms are brown with orange, green, blue and purple being added where needed for contrast next to adjoining items.[17] This tendency of Seurat's to mix colours on the palette will be examined in a subsequent section on his palette and we will try to discover whether or not he gave up that practice in his later canvasses.

The enormous Étude d'ensemble (1884) has a freshness and vigour which the final canvas sorely lacks.[18] The difference between this study on canvas and that from the earlier studies done on wood is great; the colours are fresher and brighter, the strokes are looser and quite vigorous. It has been reported that Seurat took especial care to let the layers of paint dry between each new application of paint in this étude; if so, the benefits are worth the effort. The canvas emits "pulsating light and luminous shadow"[19]; one truly has the feel of the light and can sense the warmth of the sun against the coolness of the shade.

Since the colours reacted amongst themselves without the benefit of a warm veneer as a "primer" to bind them together, Seurat used a brown ground over most of the canvas except for the shapes residing in shadow, these were undercoated with red and tints of blue and wine red to make a purple.[20] This study is free of the zinc yellow which was used in the large canvas.[21] This may help to account for the overall brightness of the study

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17 For a specific breakdown of the colours, see Fiedler, Op.cit., p. 176.
18 See Illustration 10.
19 Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 125.
20 Herbert, Georges Seurat: 1859-1891, p. 210-211. This follows the convention of Poussin and his followers who used brown or reddish-brown grounds in their works.
21 Herbert, Georges Seurat: 1859-1891, p. 210 from Inge Fiedler's research.

even though it was done on a brown ground; the absence of zinc yellow meant that the colours would have remained more intense since there was no contamination.

The brushstrokes are large and "wrap around" the three-dimensional figures the same way strips of paper are criss-crossed over and around a shape in papier mâché; they define the shape, and therefore, the depth. Compared to the strokes found in Le Couple, they are far more expressive than the tinier and more cramped strokes in the final canvas. The brushstrokes Seurat used for the little girl in white are enormous and definitely "go outside the lines", but there is no doubt what is being represented by the perfect placement of his coloured strokes. She "jumps out" at the viewer as the eye is drawn to her; everything else radiates out from her space in this study. Although it has been said that she forms the visual centre in the final canvas, I feel that the effect, which is so strong in this study, is lost in the final version.[22]

This study has a painted border which was added later by the artist on a canvas which had been restretched on the left- and right-hand sides and these later additions were primed with white.[23] Spots of orange have been added just within the border in accordance with the laws of contrast.

A final comment on this study relates to an infrared reflectography and X-radiography analysis of the work in 1990.[24] Apparently a grid was discovered underneath the painting which was used by Seurat simply to enlarge the composition from a

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22 Compare Illustration 10 with Illustration 31.

23 Herbert, Georges Seurat: 1859-1891, p. 211.

24 Herbert, Georges Seurat: 1859-1891, p.211 in reference to work done in 1990 by Charlotte Hale , associate conservator at The Metropolitan Museum of Art.

smaller version--the grid had nothing to do with the golden section scheme which previous popular conjecture had presumed Seurat had used.[25]

The 1885 study for La Grande Jatte, The Angler has a "flat" final feel, there is little depth or modelling to suggest space.[26] There are some aura-like effects on the figure with oranges and purples and the golden fishing rod is outlined in browns and purples. Varying sizes of balayé strokes are used throughout; there is no stipple effect whatsoever. The water is depicted in horizontal strokes and the reflections of the boats on the water are horizontal as well. There is very little detail, just a basic, quick blocking-in of the figures in their places. This canvas apparently has no painted border and is currently displayed within an ornate gilt frame.

Although La Seine `a Courbevoie, (1885, signed lower right, "Seurat") was done after La Grande Jatte was laid out, there are some similarities between the two canvasses.[27] This canvas contains the main female figure and the little running dog, both presented in mirror image, which were later used in La Grande Jatte. This composition is focussed very close to the water's edge and the two main figures, the woman and the sailboat, move laterally rather than perspectivally. The brushwork is tight with tiny balayé depicting the grass and foliage and more controlled and directional strokes depicting the other items; indeed, the water is almost Impressionistic with its long, horizontal strokes. The strokes on the tree trunks are so directional that they provide an excellent graphic description of

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[25] The section on the final canvas of La Grande Jatte discusses the final debunking of The Golden Section myth.

[26] See Illustration 36.

[27] See Illustration 37.

the bark. The intricate work on the tree appears nowhere else on the canvas; tiny dots halo the trunk's contours while white dots provide extra highlights in the foliage. The colour contrast practice is consistent with oranges--and some whites--indicating sunshine with purples and blues tinting the shade.

This brief overview of some of the key preparatory works for La Grande Jatte should have provided a feel for Seurat's progression towards what many consider to be his masterpiece. At some point in a study of a work as controversial as La Grande Jatte, one becomes so inured to the excellent reviews and so bored with the inconsequential that only intensive personal viewing of La Grande Jatte will suffice to answer all the questions. The next section represents my reactions to a few different times when I went to Chicago to study La Grande Jatte.

A Sunday Afternoon on the Island of La Grande Jatte

A Personal Viewing

By early 1987, I found that I really needed to re-examine La Grande Jatte for myself. I had a vague memory of seeing the work several times as a schoolchild and recall that, even then, I was intrigued by the idea of using basic, unmixed hues which would later recombine in the eye. Before travelling to Chicago, I studied any reproductions of La Grande Jatte that I could find and was surprised to find the painted-on border being shown only in some of the newer books.

Reproductions even in the best of art books are often distorted in terms of colour and sometimes, unfortunately, they are also cropped to fit into the book's format. This may not be of great consequence to someone reading just for general knowledge but it is of great importance when the reader is seeking specific information from an illustration. Of course, the border on La Grande Jatte was added four years after Seurat had begun the canvas when his theory had expanded to include work on borders, mats and frames.[1]

It has been said that when La Grande Jatte was first shown, it was hung high upon a wall in a long, narrow, somewhat darkened hallway. The frames on Seurat's canvasses were meant to enhance the work. Yet, I recalled a dirty, gold and very ornate frame rather than the simple white frame he is generally thought to have preferred. Thus, before I even began my analysis of La Grande Jatte, I was curious to see if the lighting conditions

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[1] It has been well documented that La Grande Jatte was painted in three stages with the border being added in the final stage sometime during 1888-1889. See the discussion on Seurat's palette in this chapter about Fiedler's 1982 examination of the canvas at the Art Institute of Chicago.

were suited to the painting, how it was hung, and what frame was presently being employed.

During the winter of 1987, the entire gallery of Impressionist and Post-Impressionist art at the Art Institute of Chicago was closed down so that the ceiling could be repaired.[2] La Grande Jatte, the museum's showpiece, was still on display. There were only three or four other paintings from the same era hung about the room in what, I felt, was a disappointing attempt at representing such an important time in the history of art.

La Grande Jatte itself commanded attention over all of the other works. It faced the viewer head-on once the viewer had descended half a dozen narrow steps to enter the area. The room was almost square and rather small, there were perhaps only twenty feet from the stairs to La Grande Jatte. The walls were white, or nearly so, and spotlights on tracks in the ceiling provided the main lighting. There were two skylights in the ceiling but they were far up, well recessed into the deep roof and rather dirty so they would not have provided much natural light.

La Grande Jatte is an enormous painting but was made to appear smaller by a large, white frame whose sides were approximately 9 inches across. The heavy, thick, frame "held in" the picture and obliterated any effect from the painted border when the painting was viewed from a distance. It turned out that during the intensive in-house examination of the canvas in 1982,

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[2] My visits to Chicago to study this canvas were: winter of 1987, winter of 1988-89, autumn of 1990 and, lastly, the winter of 1991-1992. The observations, unless otherwise specified, are a general compilation from all of these visits. La Grande Jatte has remained in the same position it was in during the renovations of 1987.

the white frame had been constructed and fitted around the canvas in accordance with Seurat's theory.[3]

The non-glare glass over La Grande Jatte really interfered with any attempts at a detailed, close-up examination of the painting. Other paintings of that time in the gallery were hung on the walls without any such covering. The brushstrokes on those were there to be examined. One could get up close, analyze the technique and then back off.

However, on La Grande Jatte, such examination was impossible. The glass stood in front of the painting's surface by a few inches: if it had been closer, the brushstrokes' textures would have been more visible or if it had been further away, it would have been easier to overlook the reflections. The glass was non-reflective and, although sharply defined immediate reflections were cut down, there were still reflections from the rest of the room from the people moving about and from the lights above. It was disconcerting to try to study one section of the painting only to have one's attention distracted by the reflection of one's own eye studying the painting as it watched itself.

The surface of the canvas was more speckled than I had recalled or could sense from most colour reproductions. Purply-blue specks, of a small, 3/8 inch size are sprinkled everywhere.[4] How in the world could Seurat ever have planned for an optical mixture to occur at a comfortable viewing distance of say, some twenty feet when these little spots of the final layer had lost their individuality barely a few feet from the surface? And,

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[3] Fiedler, Op. cit., p. 173.
[4] See Illustration 15.

given the overall 7 x 9 foot size of the painting, the distance where I was on the verge of finding these darker final spots beginning to blend, approximately five feet away, was certainly not a comfortable place to be positioned to "see it all". What could Seurat have had in mind?

I looked from side to side, top to bottom and then decided to check the luminosity at various distances. I left the gallery and slowly walked toward the painting again. I failed to see any noticeable increase or decrease of light: there was no extra special glow. This was not working out the way I had intended but then, what had I expected?

This painting was a hundred years old. There had to be some loss of the initial effect due to the aging process and the breakdown of the pigments. Perhaps I was being too critical and looking for the glow of Star Wars movie technology. Then again, I was looking at the work with twentieth century eyes and the knowledge of what Seurat was trying to do; or, rather, what the historians have said he was trying to do. The Impressionist school of thought had already demanded a radical rethinking of the "accepted" modalities of colour and light. Then, along came Seurat, who was trained to the convention of the day, well aware of the Impressionist line of thought and who then tried to go one step further. No wonder La Grande Jatte was such a conversation piece. So, with my mind re-adjusted, I tried again.

This time I concentrated on particular areas of the painting. Areas of grass which conformed to my mind's interpretation of "green" for grass, were, in reality, comprised of yellow-green, light green, hunter green, lilac, goldenrod, light blue and orange. This was quite a mixture when viewed up

close yet it became a definite green when viewed from a distance of about ten feet. But, was the green more luminous than it would have been had he mixed it on the palette or applied it directly from the tube?

Broad, flat strokes are quite apparent in the stretches of grass where fewer layers of paint seem to have been applied. Areas where more specific figure definition was required seem to have more layers of paint and these are done in smaller, firmer balayé. Such strokes indicate folds in materials and contours of the body. Directionality through the brushstroke becomes evident at this stage. The directionality of the strokes takes on a slightly more practical application in the tree trunks which are in the mid-ground; here Seurat uses his strokes as a sort of graphic convention to depict the roughness of the bark.

However, the areas of interplay between complementary colours and junctions of light and shade which demanded my closest attention. Still barely discernible are the smaller, directional balayé strokes. However, now, on top of these strokes, is placed a glorious riot of colours. If they could speak one would expect to hear a cacophony of sound and statements of "Hey! Look at me! I'm representing the given colour of this man's green shirt!" and "Oi! Over here! I'm showing you that I'm in the sun!" and "Excuse me, but I indicate the complementary colour of that loud, nasty child's toy!".

These busy areas are the only areas where the brushstroke nears a uniformity of size and shape. Across the canvas, strokes range in size from minute blips to generous daubs and in shape from small dots to larger, free-form smashes of colour. The busier areas, however, better depict a serious and applied use of

Seurat's theory. One can sense the germ of his scientific approach in these busy yet carefully controlled areas.

Regardless of these changes in paintstroke size, though, were there any places were "The Theory" truly worked? This was difficult to answer.[5] For me, the only area of the painting which really and truly "glowed" was the area around and including the plume on a lady's hat, the plume leapt out of the painting it was so bright. The lady is in the upper right-hand quadrant, is seated and appears almost in profile as she faces to the left.[6] The plume on her hat was so brilliantly luminous it just vibrated. I could almost imagine that the plume was made of the same feathers that today's feather boas are made; one tiny current of air passing through the soft, fluffy mass would set it all astir. This was how the colour shimmered for me, as if it were a wriggling, moving feather boa.

The colours in the plume were orange, light blue, violet, lilac, green and goldenrod. Much more white was allowed to come through, in an elliptical shape, from the North to South poles--if one likened the plume to the globe. The spots went in all directions but the end effect was that they were radiating out from the centre point of the globe-like shape. The tie or band or ribbon which would affix the plume, went around the hat and the spots on the band were aligned. For that matter, the spots on the brim and the spots on the crown of the hat were aligned so precisely that quite definite "trenches" of colour were visible.

This directionality of the spots is something which has been mentioned but not examined in any great detail. These directional spots occcur all over the painting's surface. It is

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[5] See Illustration 38 to reference the areas under study.
[6] See Illustration 39.

perfectly obvious from any reasonably decent colour reproduction that the ladies' umbrellas, for example, are very directional. The colour spots run down from the tip of the umbrella, fanning out and spreading along all the radii until the edge of the umbrella is reached. The central lady holding an umbrella in one hand and a child's hand in the other, has directional colour spots on her jacket which clearly define and more than suggest the tapering of her waist. The workman who is lounging on the left-hand side has horizontal strokes on his outstretched leg and diagonal strokes on the bent leg which continue throughout the entire mass of each leg and not just along their contours. And so on.

It seems that whenever there was a specific contour to define, Seurat aligned the spots which, as in the case of the workman's white trousers, made lighter areas completely directional. Either Seurat was so conditioned by his classical training that this alignment came about simply as a form of graphic convention or he purposely aligned the spots as a further aid for the eye to perceive the shape. If the spots were tiny enough--and these certainly were--no direction should have been needed to define the shape, nor should he have had to force the shape of the spots; there is no obvious optical basis for him to have used such directional, defining strokes. Today's colour reproductions are done with perfectly round, identically-sized spots of colour and black-and-white pointillist drawings require no difference in shape or direction of the spots to indicate changes of form or lighting.[7] Why then, did Seurat so strongly emphasize the directionality?

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[7] See Illustration 39.

Careful and painstaking application of the colours from light to dark hues will naturally lend themselves to a shape's definition. One only needs to depict an object's dimension with a technical pen to experience this effect. The density of the spots from a technical pen define a shape and can depict an enormous amount of detail. Granted, working with colours in the same manner would not be as easy as in a black and white context, and it would take a great deal of time, but it could be done.

However, the larger the size of the spots being used, the more difficult it would be to represent a three-dimensional object without distorting the shape of the dots; changing the shape of the round dots would help to indicate depth as an object's surface "goes back" into space even though it becomes affected as a result. Perhaps, Seurat did not have the time or the inclination to follow through completely with a precise colour application and so used the directional strokes instead. Whatever the reason, it appeared that he was still being lead and dictated to by the shape of the subject, and its contours, rather than by what the colours could do if given free rein.

Studying Seurat's use of directional and contour-defining spots revealed, for me, another discovery. I observed that some of the subjects appear to have very definite solid outlines or sections of outlines.[8] For example, I noticed that the left-hand side of the skirt of the lady who is fishing is, what appears to be, a solid orange line; the edge of the profile of the man in a top hat has a heavy orange outline; the upper torso of the reclining man has a sky blue outline; and, the face of the little

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[8] See Illustrations 41 and 42.

girl looking left and holding an umbrella has a heavy blue outline.

The contour of the fisherwoman's skirt is created by light blue strokes of the water and an orange line of the skirt's material.[9] This line was, most likely, the guideline for the shape of the skirt. Had Seurat strictly followed his proposed theory, there should have been a greater mixture between blue and orange--one being the complementary of the other. Therefore, no solid contour should have existed.

The heavy outline on the man's face stands out from the green grass background. Again, there should have been a better mixture of red tones to complement the green and green tones to complement the flesh colours; the almost solid orange outlines should not exist here.[10]

The sky blue outline of the reclining man offsets the orange of the shirt quite nicely but, again, it should not appear as a single line. The man is in shadow, so there is a greater use of blues and darker purple tones. Perhaps the light blue outline was the only way Seurat could "bring out" the shape without losing it to the shadows and it does adhere to his haloing technique. Or, if Seurat had been sketching in his shapes before continuing with the actual work, why would he use orange for most of the other shapes and then change to sky blue for this figure?

The blue outline of the little girl's face is more consistent with the theory since blue would complement the orangy-red skin tones.[11] However, the light blue colour of the

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[9] See Illustration 43.

[10] Consult Zimmerman, Op.cit., p. 187, figure 355.

[11] This outlining is consistent with the technique Delacroix used, around certain figures on his works at St. Sulpice, for example, which Seurat is known to have studied.

water in the background demands orange colours whenever another shape is present. Therefore, there should, again, be a better mixture of the blues and oranges rather than the description created by a solid line.

I stress that these solid outlines "appear" to exist. They may have been composed of tiny little spots afterall. However, they were of one colour which gave the sensation of a solid line or outline. And, these "outlined" figures are all in the left side of the canvas. It is interesting to note that whatever techniques Seurat may have employed on this canvas, his later works were composed of tiny dots all along the contours; what may look like a line in the camisole of his mistress in Jeune femme se poudrant is, in reality, very tiny little dots placed one after the other in perfect alignment.[12]

It has been said that Seurat worked from the left side to the right side of the canvas and that his style changed as he worked across the immense surface of the canvas. Yet, close inspection showed no obvious discrepancies in his technique from one side of the canvas to the other. There was only a slight change in the handling of a figure's definition; on the left side there was a slightly more delicate and intricate, yet very loosely handled modelling of the colours. This varied technique was especially noticable in the upper-left-hand corner. Here, one could find areas which would, if taken out of context, look like something from an Impressionist painting, so formlessly were the colours handled. One would be hard-pressed to tell the difference between a small section of this area and a lateish Monet, the strokes were so loose.[13] The right side still hinted

[12] See Illustration 44.
[13] See Illustration 45.

at this technique but tended more toward a basic filling in of an outlined shape with colour.

The spots, moving from left to right across the canvas, seemed to pick up more organization although there was no appreciable difference in the size of the spots from one side to another; they merely gave the impression of being better placed and with more certainty. Furthermore, the placement of the colours on the right was more controlled when the Impressionistic feel from the upper left-hand side gave way to a more ordered "sprinkling" of colour.

My neverending search for the solar orange revealed some orange specks here and there but certainly not the all-over, liberal covering of solar orange that Seurat was supposed to have employed. Tony Jones, the director of The Art Institute of Chicago, mentioned the fugitive qualities of the orange in the work but he seemed to imply that this was in the border moreso than anywhere else on the canvas.[14] However, a closer examination revealed traces of a burnished orange, sometimes golden, pigment over more of the canvas.

Is this all that remains of the elusive solar orange or is it the remains of some other pigment? These shimmery specks seem to be used in shaded areas, as well as in lit ones, so perhaps they are indeed solar orange residue. If Seurat did cover the entire surface of the canvas with the solar orange to suggest the effect of sunlight's glowing warmth, then those specks would seem to be all that remains of the orange. A ghostly whisper is all that remains of a very key colour in his theory and, thus, it is

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[14] This was in a letter to me in answer to my queries about solar orange.

hard for us now to conjure up the impact of the new, freshly painted work.

Seurat's practice of working with models indoors during the cold winter months and outdoors without models during the warmer months, has been noted as has the resulting distorted effect on the overall composition; the figures, both individually and in groups, ended up being out of proportion. However, what concerned me more about that method of working was that different light sources would have been used which would alter not only the shadows and their angles but also the intensities of the colours.

The setting for the painting was done outside in light which could shift from a glaring brilliance to an overcast haze. The models would have been seen under a fairly stable studio light. Trying to put indoor-lit subjects into an outdoor scene and then making everything look like it belonged together under the same source of lighting would be a daunting task, to say the least. Surely Seurat would have known of the differences that the lighting would make, but how far would he go to give up a true representation of an indoor colour to make it fit "outdoors"? [15]

Subsequent to these thoughts on lighting, there arose one concerning the degree of visible detail in varying lighting conditions. The viewer of La Grande Jatte is made to feel as if he is in the shade looking out at the scenario before him. If his eyes are sufficiently adjusted to the dimmer light, events and objects out in the sunny areas might be expected to loose some detail in the brighter, more intense sunlight. It is apparent that the sun is no longer at its height from the length of the shadows; indeed, the title itself gives us the time: the

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[15] For another aspect of this issue, see the section on Poseuses in Chapter 5.

afternoon. Strangely, though, Seurat has put in curiously little detail in the foreground shapes even though that is where the viewer is standing. One would also expect a loss of detail in the distance due to aerial perspective. Perhaps Seurat has chosen to present us with a scene that we, as the viewing public, have not been able to adjust to fully. As we step from the dark coolness of the shadows, we are momentarily blinded by the light before us.

Seurat reworked the painting after a measurable break in labour. Such a lapse of time over an entire season, and Seurat set aside La Grande Jatte for an entire summer during his first break from work, could find the artist with such a different technical approach he might be unable to achieve his goals in the same manner as he had previously set out to do. A perfect example of visual mistake due to interruptions is found in the upper-left-hand corner of the La Grande Jatte canvas: on the left, the sails of the sailboat billow and the tugboat steam trails in a wind which blows from right to left; on the right, the same actions occur in a wind which blows from left to right. Surely a non-interrupted work routine would have alerted Seurat to this discrepancy.[16]

The border, which was added during the final stage of reworking the canvas, was examined next. The spots here are larger, more oval and follow the parallel the direction of the frame. Upon examination, the borders seem to be done mostly in red and blue hues.[17] There are only about a half dozen places where any other colour is used and then the other colour appears

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16 Russell, Seurat, London, 1965, p. 147.
17 See Illustration 46.

to be orange--which could just be a faded red--with a tinge, here and there, of green.

The colours of this added border are 98% red and blue. Furthermore, why did Seurat produce a mirror-image of some shapes in the border on the right-hand side and not do this elsewhere? How can such a limited colour border accurately follow the theory of complementay colours when colours of every description run right up to the border's edge? Red is not the complementary for all colours--or even half of the colours if one allows blue to do some work. Why, then, did he use such a limited border palette? Perhaps the border colours were meant elicit their complements and "push" the overall effect towards a brighter orangey-green direction.

The top and bottom borders display red and blue horizontal elliptical shapes; these tablet-like colours are arranged in a neat, stacked column in some places and appear in greater disarray elsewhere. The left-hand side border consists of smaller and more nearly circular spots of colour. Again, red and blue predominate but the orange holds its own and, in fact, monopolizes the percentage of total orange in the paint on the border since there is no orange on the right-hand side of the border and only one or two spots on the top and bottom. Where the orange does appear, it is sprinkled over foliage and water with equal vigour.[18]

The right hand side border seemed to be comprised entirely of red and blue colours. Even though there is no orange, which suggests a loss of energy or different motives, on Seurat's behalf, the red and blue spots provide a more accurate reflection

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[18] See Illustration 47a.

of the shapes contained within the edge.[19] That is, where a dark bar runs into the edge, the border will mimic the shape in a red bar. Though both the left hand side and right hand side show a use of the mirror technique, the right hand side is far more painstakingly applied. This aspect seemed to refute completely the loss of energy theory if Seurat had worked from left to right and the greater detailing on this side suggests, again, some new motive or a refinement of an earlier goal.

The close scrutiny of the red-blue borders revealed something new. There is an inner border, especially on the left hand side and right hand sides.[20] Though the inner borders are only 1/4-inch wide at the most, they exist. And, lo and behold, these inner borders far more accurately employ the complementary and adjacent colour technique of Seurat's theory. On the right hand side, for example, the inner border is very apparent in the grassy areas whilst the other parts of the inner border are more ghostly. And, there is an orange stipple running up and down the entire length of these inner borders; this could be stronger remnants of solar orange.

So, is this inner border a timid attempt at the bordering technique and an effort to delineate the pictorial boundaries whilst enhancing the edges? Was the red-blue border the one that was added later and, perhaps, with greater confidence? Certainly the red-blue border is more vigourously applied. This stronger border, though, could also have been done in anticipation of the poor lighting conditions in the galleries. If Seurat wanted to define the pictorial edge of a painting which would later appear

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19 See Illustration 47b.

20 Unfortunately, this inner border did not reproduce well enough to be shown.

in a gloomy room, he would have had to have done something quite substantial.

There is another passing point of interest. The border colours were very cracked and dry. Some parts had flaked off. This was in noticeable contrast to the good condition of the main body of work; identical, in fact, to the condition of the large sketch The Island of La Grande Jatte (1884) and its border. Logically, the newer paint of the added borders should be in a better condition but the surface of the canvas could have been so affected by dust and grease that this layer might not have properly adhered to the surface. Reasons have never been given for this discrepancy. Speculation can only provide options but not answers.

The general feel after viewing La Grande Jatte several times, is that there are several ideas and techniques being applied all at once, all over the place. The mental and emotional strain Seurat must have experienced in trying to stay "scientific" while expressing himself artistically is very apparent; the canvas is a patchwork of approaches, each quite interesting on its own yet not really pulling together as a cohesive unit. The trees, for instance, are so entirely different from the rest of the subjects they look neglected by comparison. They are light and airy, nebulous objects while the rest of the subjects have a solid, substantial, and monumental feel about them.

Though the canvas reflects Seurat's evolving technique and theory, there is still an overriding sense of peace and calm from the composition. The carefully placed geometric figures, reminiscent of Piero della Francesca, give the painting its

serene monumentality. Repeated motifs, such as the profile of a lady, the parasols and numerous cylindrical forms, create both a surface pattern and space. The repetition of shapes produces a rhythmic movement in space as well as from side to side. The eye is lead from one figure to another, deeper and deeper into the picture before moving out again. The contrast of horizontals in the shadows with the vertical figures gives the painting stability while the simplified, static forms supply the balance. The balance, stability and repetitions join together to elicit a peaceful and eternal quality which helps to offset any tentative and disruptive applications from his new colour theory.

SEURAT'S PALETTE

Seurat's palette changed to accommodate his new and ever increasing information on colour theories. To affirm this, one only has to look at his earlier studies and large canvasses to see his initial dependence on earth colours as compared to the later works which are lighter, fresher canvasses and free of earth colours. It is well reported that Signac was supposed to have encouraged Seurat to give up using earth colours in 1884; this would have been a change which was not done overnight, but rather, in moderation and over a long period of time.[1] Then, too, one should keep in mind that the colours which appear on the canvas now, some hundred years after they were originally applied, will have altered in appearance due to grime, time, and lighting effects as well as the more insidious and far-reaching effects of chemical instability and reactions with other pigments and substances on the canvas. Only firm documentation, whether from the writings of Seurat and his circle or from tangible scientific testing of the paints on his palette and on his canvasses will help to identify the pigments he used.

Homer reports being able to view one of Seurat's 1891 palettes--which survived fairly intact from the collection of Mme. Ginette Signac--and his study revealed that eleven colours were laid out along one edge of the palette, another row, parallel to the first, comprised the same colours with the addition of white, and the final row consisted simply of mounds of white paint:[2]

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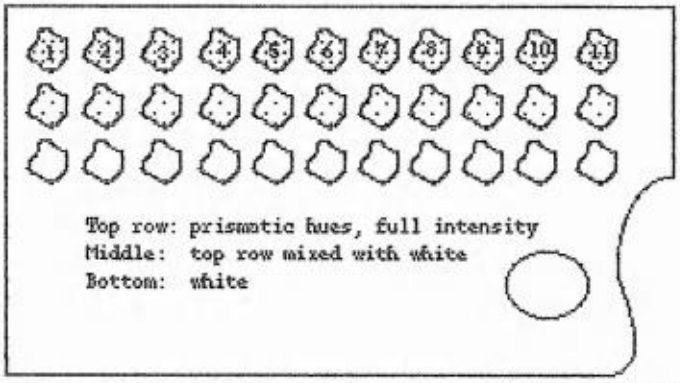
1 Robert, Herbert, Neo-Impressionists, Princeton, 1968, p. 76.
2 William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 146.



Copy of diagram from Homer,149, of Seurat's palette
Mme. Ginette Signac Collection, Paris

Homer further states that the colours seem to match those spectral colours suggested by Fénéon as based upon work by Rood. If one were to imagine "pulling" the line of colours around into a circular shape, the representation of hues would, more-or-less, match Rood's chromatic circle.[3] The choice of eleven colours may have been due to the suggestions of both Chevreul and Rood who felt that too large a gap between subsequent colours would cause a loss in intensity; perhaps Seurat felt eleven colours was sufficient to "fill in the gaps" of the original seven-colour spectral palette.[4] An interesting aside is that during the chemical analysis of La Grande Jatte in 1982, eleven different colours, and lead white, were identified in Seurat's second stage of painting.[5]

In addition to Signac's influence, or perhaps as a result of it, Seurat claimed to have eliminated earth colours from his palette between 1882-1884 in a letter to Fénéon. However, Homer

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3 Homer, Op.cit., p. 149.

4 Specific colours suggested in the theories of Chevreul and Rood will be discussed in the following chapter. Chevreul, The principles of harmony and contrast of colors, London, 1872, original 1839, p. 57 and Rood, Colour: A textbook of modern chromatics, 3rd ed., London, 1890, p. 179. Herbert, in Sutter, The Neo-Impressionists, London, 1970, p. 29, states that Seurat had nine colours on his palette which allowed for 18 colours through mixing and 36 with the addition of white.

5 Inge Fiedler, "A technical evaluation of La Grande Jatte", The Art Institute of Chicago Museum Studies, Vol. 14, No. 2, p. 177.

points out that this was not the case; earth colours were still used in Une Baignade.[6] On the palette described above, no black or earth colours were found, which would supports that that palette was from a later stage in Seurat's career. However, Homer is incorrect in stating that after painting Une Baignade Seurat finally abandoned earth colours; he could not have abandoned these colours by 1884 since iron-oxide yellow, burnt sienna and even black(!) were found during a thorough and recent analysis of the pigments contained in La Grande Jatte.[7,8]

In 1982 La Grande Jatte was taken down for examination, cleaning and analysis, while a new white frame was made for it. Since the painting had not been examined since 1957--the last time La Grande Jatte had left the premises, and protection of the Art Institute--this provided an excellent opportunity for newer tests to be applied.[9] Pigment samples were taken from specific areas of the canvas where Seurat was known to have worked and then re-worked his painting. Since the canvas was so large, obtaining samples from the centre of the canvas would have been

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6 Homer, Op.cit., p. 151.

7 Homer, Op.cit., p. 112 states that the earth colours and black were eliminated as "contributing elements to pigmentary mixtures and as components in large color areas" in La Grande Jatte.

8 Inge Fiedler, "A Technical Evaluation of the Grande Jatte", The Art Institute of Chicago Museum Studies catalogue, Vol. 14, No. 2, Chicago, p. 173-179.

9 La Grande Jatte was on loan to The Musuem of Modern Art in New York for a Seurat exhibition in 1958. While the painting was on exhibit, a serious fire broke out in the musuem but, luckily, La Grande Jatte and the other Chicago Seurats on exhibit were undamaged. Since that narrow escape, it is firm museum policy of the Art Institute never to lend La Grande Jatte again. This is not a case of over-reacting either, for transportation costs of such a large canvas would be high, simply handling such an enormous canvas would be difficult and the insurance costs for coverage during transport and venue changes would prove prohibitive. This policy is not so rare now since, as more opportunist art thefts occur, museums are becoming less and less willing to take chances with their precious possessions.

too risky; nevertheless, 180 microscopic pigment samples closer to the painting's edges were analyzed.[10]

The table below lists the pigments which Seurat used during the three different stages he is known to have worked on La Grande Jatte. The first stage was from the initial application of paint in 1884 to the interruption of work in spring of 1885, the second stage started in October 1885 when Seurat returned from a summer "break" and lasted until he exhibited the work in May 1886, and the final stage was when he added the painted border to the re-stretched canvas. Paint samples were taken from areas on the canvas which are believed to correspond with these three stages of work on the painting. Fiedler's sample areas are indicated in Illustration 38.

Comparison of Pigments in La Grande Jatte

	Stage 1 (1884-85)	Stage 2 (1885-86)	Stage 3 (Border)
Vermilion	X	X	X
Organic Red Lake	X	X	X
Burnt Sienna	X		
Iron Oxide Yellow	X		
Chrome Yellow	X	X	X
Zinc Yellow		X	
Viridian	X	X	
Emerald Green	X	X	
Ultramarine Blue	X	X	
Cobalt Blue	X	X	X
Lead White	X	X	X
Black-charcoal or bone	X (minor)		

[10] Fiedler, Op.cit., p. 173. Reflectography, ultraviolet fluorescence and x-radiography were used on the canvas itself while polarized light microscopy was used to analyze the pigment samples. Further explanation of the nature of these and other tests used can be found on page 244 of the same catalogue.

The Conservation Department in Chicago were surprised to find Seurat still using earth colours in the form of burnt sienna and the iron oxide yellow with even some minute traces of black appearing in places. Furthermore, rather than simply applying the paints from the palette, Seurat combined several pigments together; one brown area comprised "...burnt sienna, iron-oxide yellow, ultramarine blue, organic red lake, vermilion, lead white, and some black."[11]

The pigments as identified in La Grande Jatte vary somewhat from the pigments the Neo-Impressionists generally used. Callen lists these as: Zinc white, cadmium yellows, alizarin lakes, vermilion, cobalt blue, ultramarine blue, cobalt violet, cerulean blue, veridian green, and two composed greens of some mixture of chrome yellow and Prussian blue[12]. Callen's listing of pigments, and the list for the Neo-Impressionist palette is identical to that purported to be used by Seurat but comprises a generally "cooler" range with more emphasis on blues and bluey-purple combinations. Lastly, she includes the warmer cadmium yellows in her list rather than the chrome yellows which were found in La Grande Jatte.

The composed greens Seurat used may have separated with time due to improper mixing or from having been contaminated on either the palette or the canvas with other yellows or greens. Enlargements of some of the samples taken during the 1982 examination of La Grande Jatte show distinct layers of paint and varying styles of strokes. There is one blob, for instance, which appears mainly as an olive green but which shows swirls of

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11 Fiedler, Op.cit., p. 176.

12 Anthea Callen, Techniques of the Impressionists, London, 1982, p. 108. See Appendix B for a complete listing of the palettes as identified by Callen and others.

a mustardy-yellow colour at the bottom. Fiedler has verified the olive green was a combination of zinc yellow with an emerald green.[13]

Considering the analysis of the first sample from La Grande Jatte, the one which contained seven different pigments including earths and black, and the visual analysis of the above sample, there is quite a discrepancy from Seurat's theory--as it has been reconstructed today. The colour mixing procedures which were "allowable" under the theory were those which involved mixing a pure hue with white or mixing colours which were immediately adjacent to each other on the colour wheel or spectral palette. If Seurat was mixing his colours properly, then there must have been other forces at work.

Pigment breakdown from chemical instability, chemical reactions between pigments, deterioration from binders and additives in the paints and basic lack of permanence due to fugitive qualities of some pigments may all have had something to do with the changes noted in Seurat's paintings. Perhaps, Seurat had applied a new colour over one which had not completely dried; this would result in some degree of mixing. No one can say for sure. Even though Homer was able to see a palette and Fiedler and her crew were able to test sections of La Grande Jatte, we still cannot state with 100% certainty just what Seurat intended doing with his colour application or, indeed, what happened during the process of the painting itself. Though we have more answers, we still must rely too much upon speculative conclusions.

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[13] See Illustration 48. Fiedler, Op.cit., p. 178. See Chapter 3, "Solar Orange" for a further mention of zinc yellow.

La Grande Jatte: A closer look

After studying some of the preparatory works for La Grande Jatte as well as the final canvas, the final discussion on La Grande Jatte which will center on two things: 1) examining the specially commissioned transparencies (and the subsequent photographs from them), and 2) resolving and answering issues and questions which this intensive work on La Grande Jatte has raised and which subsequent research has partly resolved.

In 1987, The Art Institute provided in-house transparencies for myself and Professor Kemp (originally for publishing purposes); both colour and black-and-white photographs have since then been produced from each transparency.[1] We requested the transparencies to be as accurate as possible regarding size and colour to better enable the study of each one of five concerns which had arisen regarding La Grande Jatte. These concerns are:

Spot size and viewing distance.....Section A
Contour lines.....Section B
Complementary colours.....Section C
Direction of strokes.....Section D
Painted border.....Section E

These sections were determined to best represent each named concern even though there were, of course, many more going on.

Spots size and viewing distance: Section A

The style of dots in this transparency is representative of Seurat's earliest and most Impressionistic style.[2] The water is depicted in long and drawn-out horizontal strokes and the tree trunk is depicted similarly. The foliage in the trees is painted loosely and freely with balayé strokes which curve and cross over

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[1] The areas where these five sections are taken from are indicated in Illustration 38.
[2] See Illustration 45.

each other with great abandon; the colours intermingle and seem to be blended even in one individual brushstroke.

It has been argued that Seurat attempted to keep his colours separate and pure so that the observer might experience increased visual effects from an optical mixture. The principle of optical mixture is that the individual colour spots fuse on the retina with an increased luminosity and an incomplete fusion would result in a flickering, shimmering effect as the colours fail to blend together. Whether or not the complete fusion could occur in reality--and whether this was Seurat's intention--is a point of continuing debate. The strokes would have to be uniform and identical, of equal brightness and properly spaced in order for this to occur. Then, too, a proper viewing distance would be required. The art historians who have supported La Grande Jatte as a success in optical painting, say the painting "glows", typically at a viewing distance of twenty feet; on the other hand, some critics say the canvas is lifeless beyond about five feet from the surface. These judgements are far too simplistic.

As we have stated before, a formula (provided by Pissarro) for the ideal viewing distance of a painting is three times the diagonal measurement of the painting. For La Grande Jatte, this would be 35.4 feet! When Homer viewed La Grande Jatte, he felt that fusion was complete at a distance of 20 feet and that lustre was experienced before this point; I feel that at 20 feet, the painting is flat and any fusion, as such, occurred closer to the canvas.[3]

In 1894, a German scientist determined a scientific formula to determine the size of the image in the eye. The research of

[3] William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 143.

König concerned stimuli which were coloured and small, images which subtended 20 degrees of arc of less on the eye negatively affected colour perception.[4] If Seurat had not died so young and precipitously, his artwork would have been dramatically changed by this single finding. Given that an average sized spot on the final layer of La Grande Jatte is 3/8 of an inch across and using König's findings along with a current formula to determine the best viewing distance, the distance where fusion will best occur turns out to be a mere 5.37 feet![5],[6] Conversely, viewing this canvas at the distance of 35.4 feet, the distance determined by the first formula from Pissarro, would require that the average size of the paint strokes be 2.47 inches (6.3 cm) across. Considering that no paint strokes on this canvas measure anywhere near 2.5 inches in diameter, the two formulae provide an enormous amount of room for discrepancy between the proposed "ideal" distances.

Since there is so much variation between paint stroke shapes, sizes and colours, no one formula could possibly be universal for this canvas and we must review our criteria for "success" with optical fusion. Quantifying the precise distance where fusion occurs is difficult to pinpoint since fusion is dependent not only upon the variables Seurat created but also upon those implicit in the viewer's visual system. This, of course, is all contingent upon the basic argument of whether or not Seurat was striving towards complete optical fusion rather

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[4] König, S.B. Akad. Wiss. Berl., 21 June 1894, p. 577.

[5] This size dot is in the upper left-hand corner.

[6] The formula: visual angle = 57.3 (the object size)/distance between object and observer. The formula was provided by Dr. Gerry Quinn, Psychology Department at the University of St. Andrews. He stated that when a person views his thumb at arm's length, the image subtended on the retina will be roughly equivalent to 2.5 degrees in visual angle; this, he added wryly, was vision's "Rule of Thumb".

than towards the increased lustre that incomplete optical fusion seemed to provide.

Contour lines: Section B

Seurat was not supposed to have used contour lines in La Grande Jatte. However, this section shows one instance, of several, where it appears that he put in a solid line as a guideline for a figure (see previous section on my personal viewing of La Grande Jatte.) The edge of the fisherwoman's dress has a distinct line around the lower edge where the skirt meets the background blue of the water.[7] Although it was impossible to be certain whether the line was solid and continuous or dotted in due to the distortion from the glass, the line seemed to be stroked in with no visible joins. The "lines" may simply be a carryover from his classical training.

Complementary colours: Section C

This transparency shows the four main complementary colour pairs, as suggested by Rood; Seurat used Rood's suggestions for local colours in La Grande Jatte while employing adjacent colours to increase the luminosity.[8] Although the technique of simultaneous contrast is Chevreul's, Seurat used Rood's colour pairs instead.[9] One of the strongest instances of hue and value contrast is found in the pair of sitting girls.[10] Firstly, the bodice of one is the colour complement to the other's skirt; and, obviously, vice versa. The yellow-greens in the sunlit grass are the 90-degree colour complements to the blue-violets in the skirt and the violets in the shaded grass. The blue-greens of the

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[7] See Illustration 43.

[8] See Illustrations 41 and 42 for the identification of instances where Rood's colour pairs are used in La Grande Jatte.

[9] William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 136.

[10] See Illustration 49.

bodice and the very dark grass are the 180-degree colour complements for the red-orange of the other skirt.[11] Furthermore, where the coloured areas overlap, the complementary colours also act as surrounds. The blue skirt is surrounded by a band of orange sprinkles, for example.

There are many examples of Seurat "haloing" a figure with its ambient complementary colour to make it stand out from the background. Where the blue-violet dress of the main standing woman is ringed with yellow and, where it abuts onto her companion's coat, orange dots are sprinkled. There is, as mentioned before, a strong blue aureole effect around the reclining man's reddish-orange shirt. Other complementary combinations abound: the monkey is spotted with yellows and purples; the sniffing dog is purple to complement the green grass; and so on.

It must be noted that although Seurat's complementary colour usage increases the effects of simultaneous contrast, it actually negates any possible effects from optical mixture since the colours become muddier through any possible optical mixing. It is as if by physically painting in this optical effect--which would have occurred naturally in the eye--Seurat has managed to cancel out exactly what he wished to achieve. Instead of allowing the viewer to find the visual effects, he has overloaded the initial presentation and allowed no room for adjustment.

Directional strokes: Section D

This transparency shows how the slightly more regular strokes from the middle of the canvas still retain strong directionality where shapes need to be defined. This

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11 Rood, Op.cit., p. 292.

directionality is most distinctive in the hat, especially when compared to the mixed dotting on the hair of the hatted woman's companion.[12] The curve of the brim is defined by the dots while the crown of the hat has another set of dots defining its shape. Seurat has dots marching down in straight lines or curving round bends. As far as the increased luminosity is concerned, absolutely nothing of that quality comes through in this photographic reproduction where the lovely plume looks more like a dried out hydrangea than a fluffy decoration on the hat.

Painted borders: Section E

The enormous size of the border dots is shown in this transparency and it is also possible to note the dried and cracked state of the paint.[13] The texture of the canvas is visible through these border strokes and it is evident that the dots have been applied sparingly and without much layering. Nevertheless, the dots just inches away, within the bounds of the scene, are layered up and blended much more effectively. Even the dots in the trousers, where the canvas texture still remains visible in places, seem to be thicker and creamier in consistency. There are some large white dots on the trouser leg which run inside the border and some slightly orange dots which run inside the border on the grass. Was this some quick and rather ineffectual attempt at complementary colour usage? Although the directionality in the trousers' spots is evident, and has been discussed before in greater detail, the directionality of these border strokes is determined by their size. The strokes themselves are so large, there is little choice in how they can be aligned within the given space.

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12 See Illustration 39.
13 See Illustration 46.

The issues which I still want to resolve are why Seurat choose those colours for the borders and why the spots are so enormous and applied with a seeming slap-dash abandon. It has been suggested that the colours of red and blue were meant to hem-in the visual scene; the blue being cooler and acting to enliven the colours within its bounds while the red was meant to give some life and warmth to the otherwise cool and indifferent blue. Though this sounds accepable and, frankly it is as good an argument as another, I still cannot understand why the border, which was added years after the original canvas, appears so crudely applied and in such basic colours; one would have expected a more refined technique with the passage of time.

There was a considerable amount of activity in La Grande Jatte as Seurat worked to put theory into practice; his technique had to change to accommodate new practices and he had to sort out how much of his training and experience he was willing to compromise or sacrifice altogether. Techniques such as the mastery of value relationships, which he had gained through his drawing practice, were invaluable to his paintings and were not given up.

Seurat seemed to desire a monumental harmony in the canvas. Evidently, he painted the final canvas while it hung on the wall, and some people have even believed that the wall was to "contain certain harmonic potentialities".[14] While I will not enter into the discussion about properties which walls in studios may or may not contain, I would like to note that this comment simply verifies that Seurat was still working along the lines of thought from his classical training. His procedure and the handling of

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[14] Russell, Op.cit., p. 156, quoting Rudolf Wittkower.

the basic components are still strongly and consciously dictated by his past education.

The aspect of producing numerous studies, for example, reflects back to the training in the Academic tradition. It must be emphasized, however, that the exact order of Seurat's sketches is not known nor is it certain which sketches were done on site and which ones were done in the studio; only style changes or material identification can help to place them temporally. However, caution must be taken when trying to order Seurat's studies based upon style changes alone. He was trying so many different techniques that identifying a firm progression in his technical growth would be almost impossible since the permutations of his techniques and their variations are endless. Even if a systematic progression was loosely applied to Seurat's techniques, can we be certain that is was his progression which was identified and not one which we had created to fit?

The new Seurat scholarship generally agrees that, "The many studies for Seurat's major pictures did not form a steady progression toward a preconceived composition but were instead disparate essays, few of them constituting units or fragments of the final pictures."[15] Normally, and Academically, studies are considered to be forerunners to "the grand machine" and not concurrent devices, but it seemed that Seurat preferred to use his studies as tools for fine-tuning his technique. So, though the majority of guidance was from Seurat's past, there were numerous indications in the work towards and on this canvas of his desire to break free and try something new.

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[15] Robert Herbert, Georges Seurat: 1859-1891, New York, 1991, p. 5.

As with all the other aspects of his works, Seurat did not leave his subject matter to choice and numerous suppositions have existed regarding the societal commentary of Une Baignade versus that of La Grande Jatte. Until recently, the original site of La Grande Jatte had been thought to be just opposite the site for Une Baignade, and the first canvas was thought to examine a different class of society than was examined in the latter canvas.[16] This rather simplistic view has now been expanded to show that Seurat's canvasses depicted only those items from a chosen site which would serve his means to provoke a specific reaction and elicit a specific response. Basically, both of these early canvasses dared to examine aspects of a society which were burgeoning: industry, commerce, and business with the new reward--a weekend of relaxation for its participants.

In La Grande Jatte, moreso than in Une Baignade, one can sense where the class divisions become fuzzy as town and country become more mixed while workers and middle classes relax or promenade on their precious Sundays. The subject matter of La Grande Jatte has been a focus of speculation for years and judgements have ranged from La Grande Jatte being a piece of "direct social observation" to a product of a rich and "...poetic imagination, and one whose meaning still eludes us".[17]

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[16] In a talk given on the 7th December 1991, Bogomila Welsh-Ovcharov carefully explained her research about locating the actual sites for several well-known paintings. With the aid of old photographs and maps, she explained that Une Baignade and La Grande Jatte were not painted from opposite banks of the river, La Grande Jatte was quite a distance from the site for Une Baignade. Furthermore, Seurat's selectivity in presenting what was actually on each site has implications for some of the recent social reviews of his works and will be addressed within the context of each painting. (Title: "Seurat, His Contemporaries and the Outskirts of Paris", at the Metropolitan Museum in New York)

[17] Russell, Seurat, London, 1965, p. 142.

Some scholars believe that the subject matter and the way it is treated are inseparable. The subjects' poses in La Grande Jatte are monumental, like a classical relief sculpture, and the fresh lighting effects and colour techniques fit in well with the figures' presentation.[18] Yet, for all of these complementary techniques and approaches, Seurat showed groups which experience little, if any, interchange; any thought of relationships between members in La Grande Jatte is so obscure that making a connection becomes forced and artificial. The people are wearing the latest fashions, showing off who they are and doing it in a place of relaxation on a Sunday afternoon and, yet, they are stiff and refuse to interact with the others.

Perhaps it was not the subject matter and any associated social commentary that primarily concerned Seurat--as part of his means--but, rather, it was the visual effects which focussed his attention--to achieve the end. The initial, determined chosing of his subject matter from a given site; the actual, physical layout of the subjects within a frame; the techniques used to present these subjects to the viewer coupled with the unspoken visual games all suggest, and represent, the methodical process of Seurat.

Thus, in La Grande Jatte, Seurat managed to achieve several things. Seurat was able to apply, to some extent, the laws of light in nature to a two-dimensional surface. He was able to define, develop and employ a chromatic value scheme which neatly knit together his expertise in chiaroscuro techniques with his skills in colour; and, he harmonized his colours according to the laws of contrast and analogy. His presentation of the unbounded,

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[18] Jean Sutter, Ed., The Neo-Impressionists, London, 1970, p. 28.

restructuring classes in society seemed to mimic his unformed and less structured techniques. While Seurat eventually incorporated research on pictorial representation, composition and the expressive methods of lines and direction into his theory, it is the initial work with colour which comprised the main focus of La Grande Jatte.

CHAPTER FOUR

Seurat's early "scientific" sources

Can there be a quantifiable relationship between scientific theories of colour and an artist's vision and intuition regarding colour usage? We have already established that, given certain parameters, such a relationship can exist, and that Seurat, in particular nurtured such a relationship, even though the measurement and effect of the factors in such a relationship is difficult to obtain. Science offers multiple theories and formulae regarding how light may be broken down and then made whole again. There is no doubt that such formulae and theories serve to secure the balance of colours in the optical sense but this "optical sense" and its scientific origins differ quite markedly from the artistic sense. There are what may be termed more human or sentimental forces at work in an artistic approach which may overrule and even are capable, at times, of reversing some of the optical laws concerning the early stages of vision.

Seurat is known to have read and studied writings and publications by several scientifically-oriented researchers of the early nineteenth century. Some of these researchers were trained as physicists or chemists whilst others had technical backgrounds outside of the sciences. Still others had backgrounds in the arts but were driven by urges similar to Seurat's; to find the best way possible to depict a desired image of something three-dimensional onto a two-dimensional surface. There exists irrefutable proof, in the form of notes taken down

by Seurat, that he studied some of these authorities. Researchers with scientific backgrounds are highly likely to have influenced Seurat either by his directly reading their publications or by his hearing of their research in related discussions. Though we cannot say with 100% conviction that he read the major publications of Helmholtz, for example, we can surmise that the impact of Helmholtz's research and its far-reaching consequences would not have failed to attract Seurat's attention. He would have been introduced to Helmholtz through Rood's book, if nothing else.[1] Seurat had an enquiring mind and was open to new interpretations and approaches, especially if he thought a new piece of knowledge might further his cause. It is with these thoughts in mind that we now turn our attention to some of the early nineteenth-century researchers of whom we know Seurat studied.

Chevreul

Chevreul (1786-1889) was teaching, working and publishing scientific papers by the time he was 20 years old and by the time he was 30 he was Professor of Chemistry and Director of the Dyes houses at the Gobelin tapestry works.[2] It was while he was employed in the tapestry works that he noticed certain colour phenomena which he published in 1839 as The Principles of Harmony and Contrast of Colors.[3] His work proved to be a major influence on the works of the Impressionsists. Delacroix is known to have

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[1] For the best discussion on the possibilities of Seurat having read publications of Helmholtz, see Homer, The Science of Painting, Cambridge, 1964, p. 289, note 29. Here Homer agrees that Seurat would have known of Helmholtz but identifying which texts or articles Seurat would have read, and when, is a matter more of speculation than fact.

[2] Birren, History of Colour in Painting, 1965, p. 210.

[3] The original De la loi du contraste simultané des couleurs was published in Paris in 1839, the English translation by Charles Martel, The principles of harmony and contrast of colors, was published in 1872..

relied upon this text[4], and Seurat is known to have read and annotated the text as well.[5]

In the first part of his book, Chevreul explained simultaneous contrast of colours, saying that there are two modifications possible with two contiguous colours: 1) contrast of tone which affects the intensity of the colours and 2) contrast of colour which affects the optical composition of the colours[6]. His observations about the laws of simultaneous contrast, were that the contrasts "...are at a maximum and most noticeable where the two colors are similar in value (lightness or darkness)."[7] Simultaneous contrast with colours of a different hue, however, "...will tend to 'spread' still farther apart from each other; colors of a different value (brightness) will tend to appear still lighter and darker by contrast."[8] This means that simultaneous contrast with a light and a dark colour will not be as dramatic as simultaneous contrast with colours of similar or equal value.

For example, having a green next to a purple, with each being of equal brightness, will make each colour more intense from the adjacent colour's complementary; the green appears more yellow from the purple's influence and the purple appears redder from the green's influence. However, it is Chevreul's following discussion on juxtaposing simple colours with compound colours that offers new possibilities to the artist. By placing an

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[4] For a complete discussion of Delacroix's colour usage and theories, consult E. Johnson's Delacroix, London, 1963, which was based on his unpublished 1958 thesis at Cambridge entitled, "Colour in Delacroix: Theory & Practice".

[5] Robert Herbert, "Seurat's Theories" in Jean Sutter's The Neo-Impressionists, London, 1970, p. 23.

[6] Chevreul, Op.cit., p. 4.

[7] Faber Birren, Color Perception in Art, New York, 1976, p. 22.

[8] Birren, History of Colour in Painting, 1965, p. 211.

orange next to a green, the orange will appear redder and the green will appear bluer; this is because yellow, the colour they have in common, has lost what visual impact it may have had originally as the two colours "pull apart" from each other on the spectrum.[9] Knowing the effects from simultaneous contrast will enable the artist to achieve heightened colour effects.[10]

Chevreul applies his contrast laws to all the permutations of the primary colours of red, yellow and blue and the secondary colours of orange, green and indigo.[11] Identifying the primary and secondary colours in this fashion is, in itself, not novel at all and Chevreul agrees painters and dyers have used these colours for ages. However, in all his discussions on colour, he refers only to those six main colours or slight variations of them. Chevreul never intends that earth tones or black are to be considered since these colours are not used effectively in paintings which are trying to capture the freshness of light.

In the final section on the first chapter, Chevreul clarifies the differences between simultaneous, successive and mixed contrasts. The first has already been defined; the second involves afterimages in the opposite colour from that which was originally presented, and the last is a complicated mix of new colours impinging upon an afterimage. The fact that successive contrast is experienced by the phenomenon of afterimages has been noted by artists for hundreds of years; however, it took until

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[9] Chevreul, Op.cit., p. 26.

[10] Chevreul carefully explains the effects of such positioning and, although any artist could obtain the same information by experimentation, the quick cause-and-effect discussion and charts provided by Chevreul save time.

[11] The primary colours are the fewest number of colours needed to form white, in light, or black, with pigments. The secondary colours are created from combinations of the primary colours.

Chevreul's time to get an explanation rather than just a notation of this effect.

In the second part of the book, Chevreul applies the law of simultaneous contrast and works out chromatic diagrams; this is what Seurat would have been interested in once he understood the basic principles being applied[12]. Seurat did copy out sections of Chevreul's book and studied the positioning of contrasting colours as Chevreul recommended and which Delacroix actually employed; in fact, Seurat seemed particularly enthralled with the rich and luminous greys Delacroix obtained from the visual mix of juxtaposed complementary colours.[13]

After setting up his chromatic diagrams, Chevreul discusses harmonies using either analagous colours or contrasting colours and explains how versions of each may be used to the best effect[14]. With the aid of the chromatic diagrams and the charts indicating harmonious colour combinations and how to find them on the colour wheel, an artist can be assured of using the colours which will best meet his needs.

Chevreul reminds the reader that just because a painter uses colour does not automatically entitle him to the label "colourist" because, for example, a red may not be a true red if its value is wrong; thus, an engraver with good perspective skills and capabilities of rendering form would be more respected than a poor colourist.[15] Even if the painter has sufficiently mastered value relationships, the painting may still be poor if the colours do not harmonize across the canvas' surface.[16] For

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12 Chevreul, Op.cit., p. 34-49. See Illustration 50.
13 Herbert, "Seurat's Theories" in Sutter, Op.cit., p. 24.
14 Chevreul, Op.cit., p. 48.
15 Chevreul, Op.cit., p. 83.
16 Chevreul, Op.cit., p. 85.

example, the "principle of harmony of contrast then procures for the painter in chiaro-'scuro the means of realising, with respect to brilliancy of colours and distinction of parts, such effects as are produced in paintings of flat tints."[17] Again, a skilled painter can use colours which may seem widely diverse at first but which, in reality, form harmonious triads or pairs on Chevreul's contrast diagram.

Chevreul was very specific that optical mixtures of complementary colours will produce grey; and this maxim was illustrated perfectly by Delacroix's rich and luminous greys.[18] Although the effect of simultaneous contrast will be intensified with the use of complementary colours, optical mixtures of complementary colours produces gray, not an intensified version of the original colours. Only visual mixtures of colours adjacent to each other on the colour contrast diagram will yield increased luminosity.[19]

It is this key difference which Seurat failed to apply properly and consistently. A letter from Charles Angrand verifies that Seurat did mix colours which were next to each other on the scale but his mixing of complementaries in other places put the colours in collision and the result was dulled, grey colours.[20] Perhaps the final colour balance was destroyed when Seurat decreased the size of his strokes. Large areas of complementary colours will become intensified and more brilliant

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17 Chevreul, Op.cit., p. 85.

18 Chevreul, Op.cit., p..

19 Rood, Modern chromatics: Students' text-book of color with applications to art and industry, New York, 1973 edition, p. 42. Although simultaneous contrast was identified by Chevreul, it was Rood who repeatedly stressed using adjacent colours to increase luminosity, warned against the use of complementaries for the same purpose and backed up his findings with rigorous experiments and scientific measurements.

20 Rewald, Seurat, 1990, p.77 referring to the letter cited in Seurat by Coquiot, p. 40.

as their differences are exaggerated; however, if the areas are too small, the colours will become blended and neutralize each other to form a grey.

In actual practice, Seurat often had to paint in the effects which Chevreul had described; darkening edges next to lighter areas and vice versa and adding touches of complementary colours on edges since the pointillistic style he used did not always elicit the results which Chevreul had noted. Additionally, even though newer research from Rood and Helmholtz made subtle yet quite significant changes in the identification of the colour primaries, since both Rood and Helmholtz were quite clear about colour primaries for light versus those for pigments, Seurat seemed more inclined, initially, to continue to use the primary colours as labelled by Chevreul.

This disinclination of Seurat's to adapt his technique to the new research began to cause him difficulties on the canvas. Perhaps Seurat felt a loyalty to Chevreul for his strong ideas of harmony, thinking that a harmonious display would pull together any number of disparate factors; Chevreul had equated "...the maximal contrast of the complementaries with maximum harmony."[21] Perhaps Seurat's ultimate desire was not perfect optical fusion or a pleasing colour harmony but involved other factors altogether. Only our continued examination of the influences on Seurat will help us to resolve these issues.

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21 Chevreul, Op.cit., 237.

Charles Blanc

Charles Blanc (1813-1882) was a leading editor, critic and art historian; he was trained as an engraver, founded the world-famous art magazine Gazette des Beaux Arts[1] and taught art history at the College de France.[2] As his theory evolved, he described optical mixtures and ascribed emotional significance to colours and mental associations to lines.[3] Unfortunately, since he didn't always sign his pieces or acknowledge his authorship, even though most of the pieces were published, it is difficult to assess the direct evolution of his thoughts.[4]

Seurat's earliest contact with the writings of Charles Blanc was when Seurat was still a student. Seurat is known to have read some of Blanc's writings, as a letter from Seurat to Fénéon in 1890 attests.[5] Furthermore, Seurat mentions that he was familiar with Chevreul's laws and Delacroix's percepts, that he knew of Corot's ideas on tone, and of Couture's ideas on tint, that he had read Sutter's writings on Greek art and was aware of the ideas and theories of Rood and Henry respectively.[6] However, it is the effect of Charles Blanc's writings which will be examined here.

Blanc's Grammaire was written in two parts: the first comprised a descriptive list of aesthetic principles, and the second part involved the application of these principles to the

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1 This publication is still being produced over one hundred years later.
2 Misook Song, Art Theories of Charles Blanc: 1813-1882, Michigan, 1984, p. 1.
3 Faber Birren's introduction to Rood's Modern Chromatics, pub. New York, 1973, p. 51-2.
4 Song, Op.cit., p. 18.
5 Richard Thomson, Seurat, Oxford, 1985, p. 224 of the Appendix for a copy of this letter which has been translated into English.
6 Thomson, Op.cit., p. 224.

fine arts.[7] Blanc believed that there was a dichotomy between man and nature and that man's efforts in creating art were done in order to worship the sublime.[8] Basically, Blanc believed that the artist's duty was to order nature and then elevate it, and that there was a certain moral function embodied in these tasks. This idea of morality and transmitting it through art was supported by Henri Lehmann in his teachings at the Ecole des Beaux-Arts, under whom Seurat had studied and, undoubtedly, been indoctrinated.[9] Perhaps unconsciously at first and then with greater determination later on, Seurat chose to emulate Blanc's manner of living.

The emotional connotations of colour derived from Blanc's belief that colours were feminine and instinctive, with their main purpose being to express emotion, thought and moral character. An often quoted line from Blanc regarding the emotional power of color is, "to tell us what agitates the heart.." since a manipulation of colours can elicit specific emotions.[10] The morality of colours meant that some colours are more appropriate than others for eliciting certain moods. It is possible to discern an influence from Blanc's line of thinking in Seurat's later works, and those begun after 1886 certainly seemed more refined in dealing with the effects of colour, movement and motion.

For example, an application of Blanc's sentiments in a practical manner involved chiaroscuro techniques which, because

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7 Song, Op.cit., p. 33.

8 Song, Op.cit., p. 34.

9 Thomson, Op.cit., p. 19.

10 William I. Homer, Seurat and Science of Painting, Cambridge, 1964, p. 29, quoting Blanc from his Grammar, same edition and translation as cited previously, p. 146.

of his emphasis on morality, took on more significance than just the simple representation of light and dark. Transparent shadows and impasted lights were the praiseworthy techniques in paintings for Blanc, since they expressed an inherent high morality, while those works which lacked this technique were criticized for their subsequent lower moral tone.[11] Yet, as paint became more consistent from mechanical production, techniques developed so that both the darks and lights could be applied thickly. It is possible to see how Seurat reconciled these changes technically but whether he managed to reconcile the moral implications of the changed materials is something we will never know.

Blanc's major colours were yellow, blue and red, with violet, green and orange making up the binary colours; black and white were to be used sparingly to enhance and refresh the six basic colours.[12] Blanc used Delacroix as a reference not just for the artist's colour usage but for Delacroix's "quasi-scientific" application of colour; he encouraged artists to copy this master's methods to enliven their works.[13] Blanc knew Delacroix personally and wrote of their discussions on colour as well as explaining Delacroix's colour theory.[14] Delacroix's use of broken paint strokes in addition to his application of colour opposites to increase colour contrasts were cited by Blanc and noted by Seurat, both from Blanc's references as well as from studying works of Delacroix.[15]

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11 Anthea Callan, Techniques of the Impressionists, London, 1982, p. 27. Blanc was not alone is this moralistic judgement of a painting technique.
12 Blanc, Op.cit., p. 159. See Illustration 51.
13 Herbert, "Seurat's Theories", in Sutter's Neo-Impressionists, London, 1970, p. 23.
14 See Blanc's two-part article "Eugéne Delacroix", Gazette des beaux-arts, Feb. 1864.
15 Herbert, "Seurat's Theories", 1970, p. 24.

Blanc's theory of optical mixing, based upon Delacroix's broken paint strokes, predicted colours being recombined in the eye to greater effect than colours which had been physically blended together; the name coined for this technique was "mélange optique". Blanc realized that new tones could be formed by an optical mixture of closely situated colours "..if the observer moved sufficiently away from the painting in question."[16] In order to achieve these effects, Blanc suggested the artist use dots, or stars, or small stripes of colour to encourage blending. Basically, these are reminiscent of the possibilities which had been espoused by Chevreul for optical mixing some 30 years earlier, even though Chevreul was speaking more of residual colour mixing which occurred though improper simultaneous contrast applications.

The other key contribution from Blanc was the autonomous meaning he believed was inherent in lines. Although this is directly traceable in origin to Humbert de Superville, most literature cites a direct connection from Blanc to Seurat.[17] Blanc was influenced by the ideas of Humbert to such an extent that some feel he, "...quite literally plagiarizes Humbert's idea [that man is an extension of the earth...]"; especially when Blanc begins his discourse about the communal emotional experience in man.[18]

Blanc believed that there was a common human experience which meant that certain directions of movement, and certain

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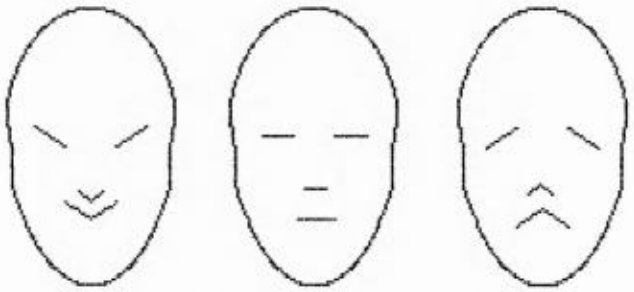
[16] Homer, Op.cit., p. 32. The fact that distance was mentioned by Blanc, amongst others, but forgotten by the time it came to criticize the paintings is part of a continuing cycle faced by supporters of divisionist art styles.
[17] Barbara Stafford, Symbol and Myth: Humbert de Superville's Essay on Absolute Signs in Art, London, 1979, p. 181.
[18] Stafford, Op.cit., p. 180.

colours, would elicit similar reactions across the broad spectrum of humans. For example, a simplification of the physiognomy of the features in the human face, as depicted in the three schemas below, would provoke similar reactions from people.



Three schematic faces as suggested by Blanc (1870, p. 36) [19]

Blanc does elaborate upon Humbert's ideas of emotion being associated with visual movement: Upward implies gaiety, downward evokes sadness and horizontal movement is equated with calmness. Regardless of the origin of the idea, an application of this is not seen in Seurat's work until the late 1880s.

An excellent example of emotion-movement connection can be found in Seurat's depiction of the spectators in Cirque; their slanty-eyed features were a direct influence of Blanc who had formed a connection between between the Chinese physiognomy and their architecture--which he believed indicated a universal "..prototype of hilarity."[20] Again, it was the works Seurat began after 1886 which evinced more traceable influences from Blanc.

Basically, the message from Blanc was that the artist had to rely upon the classical or formal background and training which

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[19] Song. Op.Cit., p. 57. Although these figures were shown in the 1870 edition of Blanc's Grammaire on p. 36, a fuller description of their use and "provenance", if you will, is found in Song's treatise.

[20] John Russell, Seurat, London, 1965, p. 133, referring to p. 117 in Blanc's Grammaire. See M. Zimmerman's, Seurat and the art theory of his time, Fonds Mercator, Antwerp, 1991, p. 381.

would best enable him to proceed with newer ideas; the basic skills and foundations must be mastered before newer techniques could be applied. For example, the section on perspective by Blanc is more pragmatic than theoretically-oriented. Even so, one suspects that, once Seurat had gathered the basic constructs from Blanc's material, then the balance went much more toward the theoretical side. One need only to look closely at La Grande Jatte, for example, to see a large amount of traditional pictorial techniques which were required to achieve the desired outcome, even though his burgeoning theory did not suggest or account for such techniques.

Recently, Herbert has wished to emphasize that Blanc provides the key towards the broad attitude of Seurat and his relationship between making a picture and using science; however, Herbert gives the misguided impression, to my mind, that Blanc provided the greatest influence in Seurat's theory.[21] Herbert's emphasis on Blanc's importance to Seurat seems too strong; one cannot say that Seurat's paintings are a natural outcome of, or can be explained by reference to, Blanc's writings over all others. There is an influence from Blanc, yes, but not an over-riding dictation of style and technique.

Since Seurat had read Blanc as a schoolboy, one wonders how a reading at such a young age would have produced such a lasting impression that no subsequent theories could have equalled or challenged its effect. How could Seurat have developed a theory of his own and synthesized the salient points from existing theories by numerous writers in several fields, if he had been so singularly affected by Blanc? The gist of Blanc's ideas is felt

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[21] Herbert, Seurat: 1859-1891, 1991, numerous mentions.

in Seurat's pieces but it is not until his later works that direct pictorial evidence becomes apparent in the visages of the people in the paintings. If Blanc's influence, with an equal influence from Superville through Blanc, had been so strong, surely these visual signs would have been apparent much earlier on in Seurat's career. The fact that Seurat read Blanc at an early age and employed some of his concepts before re-employing more of Blanc's concepts later on, suggests to me that Seurat returned to Blanc for inspiration rather than relying upon him continuously for ideas.

Humbert de Superville

The Dutch painter-theorist David Pierre Giottino Humbert de Superville (1770-1849) wrote Essai sur les signes inconditionnels dans l'art, the first section of which was published in 1827.[1] This is basically a treatise on physiognomy in which Humbert discusses how humans interpret meanings in faces from the directions of the individual parts--eyes, nose, mouth--before he extrapolates this notion to the point that "...certain directional lines and colors will infallibly, unconditionally, and for all men, convey certain emotions."[2] From a long and intensive study of nature and human anatomy, Humbert attempts to link three usually disparate dimensions: the physical, intellectual, and moral. He developed a system of signs from his studies which he believed could be used to exhibit and elicit specific reactions.[3] It is this notion, more than anything else provided initially by Humbert and later supplemented by Blanc, which appears in graphic representation in two of Seurat's later paintings, Le Chahut and Le Cirque.

Not only could lines serve as vehicles of expression but colours, too, could be used to convey feelings. Humbert outlined a basic colour system which had symbolic associations. The three primaries black, white and red which represent dark, light and fire, respectively, are interspersed with yellow (between white and red), blue (between black and white) and green (between black and red) with green representing nature and life.[4] On their own merits, these colours have little in common with the colours used

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1 Barbara M. Stafford, Symbol and Myth: Humbert de Superville's Essay on Absolute Signs in Art, London, 1979.
2 Stafford, op.cit., p. 31.
3 Stafford, op.cit., p. 89.
4 Stafford, op.cit., p.32.

by Seurat. It was not until Humbert showed how the colours had become associated with eliciting certain emotions that Seurat's interest was arrested. Humbert's expressive theory united line and colour and showed how they reinforced one another in expressing emotion. Seurat himself is known to have referred to his canvasses as "'toiles de lutte' (canvasses of combat), also as 'toiles de recherches et si possible de conquête' (research canvasses, conquests if possible)" which suggests that he was well aware of the emotional impact of his lines and colours.[5]

In the second book of his essay, Humbert indicates the relevance of the primary colours and forms, as he has set them, to the arts. Painting, he felt, was a visible expression of a human thought when the intellect captures a moment in time and the mind expresses the concept by signs--via primary colours and forms and their associated aesthetics.[6] Humbert provided a simple schema for those interested in employing his concepts which he depicted in a synoptic table.[7] If one were to cite the basic directions, the associated states of mind and their metaphorical analogies, the basic layout would be as follows:

Expansive	Horizontal	Convergent
Vacillation, agitation	Equilibrium, calm	Concentration contemplation
Scattering	Order	Solemnity
Explosiveness refulgence	Brightness, light	Depth, Darkness
Red	White	Black[8]

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[5] The first comment was in a draft of a letter to Beaubourg (held in the de Hauke archives) while the second was noted by Verhaeren in "Georges Seurat", 1891.

[6] Stafford, op.cit., p. 37.

[7] Consult William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 203 originally from Humbert, Op.cit., p. 25.

[8] Stafford, op.cit., p. 85.

The final part of Humbert's essay was never published. What remains important, though, are Humbert's notions about the moral and psychological implications of line, colour and form and how much Seurat came to rely upon them. Indeed, in Seurat's later paintings, perhaps more should be attributed to Humbert's general influence, rather than that which is normally attributed to Henry's more scientifically-oriented concepts. We will keep this in mind as we examine these paintings and, in the discussion on Henry, we will see where Humbert and Henry overlapped ideas, where they diverged and, more importantly, from where Seurat drew his ideas.

Goethe

Although Goethe had no direct effect upon Seurat, his ideas did have an impact upon researchers who subsequently influenced Seurat. Goethe believed that colour perception was the result of the outer world impacting upon a receptive organism and that it was the interaction between light and dark which produced colour.[9] Goethe's colour theory, which was first published in Germany in 1810 before reaching the French world in 1870, stated that

> "...yellow, red, and purple become visible when light reaches our eye through a dark medium. In contrast, blue and violet become visible when the illumination is shown against a dark background. Yellow and blue are the basic natural colors...all the rest are derived by either lightening or darkening the two primaries."[10]

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[9] Goethe, J. W. von, Theory of colours (Intro. by Deane B. Judd), Cambridge: MIT Press, 1970, from original German 1810 publication.
[10] Stafford, op.cit., p. 60.

Basically, Goethe's system was one of polarities with the "plus" movement shifting toward light or yellow and the "minus" movement swinging toward dark or blue. Almost inherent, and certainly suggested, within this two-ended colour theory is the emotional significance of the colours: the plus-yellow colours are positive, lively, full of energy, forceful, contain warmth and have an affinity with acids; the minus-blue colours are negative, cold, weak, indicate deprivation, produce anxiety, show distance and have an affinity with alkalis.[11] A combination of the two colours of yellow and blue would produce red, a high energy colour; the plus- or minus-factors of various reds being determined by the amounts of yellow or blue, respectively.[12]

The idea of the emotional significance of colours in Goethe's theory has continued to appear in subsequent theories, one of the most important, for Seurat, being that of Charles Henry. While Seurat leaned more and more towards the emotional aspects of colour in his later works, Goethe worked exclusively with the emotional and subjective aspects of colour; the empirical account of colours as a phenomenon separate from perception was given no room in his theory.[13]

Although certain aspects of Goethe's theory have failed to withstand the tests of time, he did make rather significant observations about brightness, afterimages and coloured shadows, for example, which other scientists and researchers have advanced. Again, although the direct impact of Goethe's observations cannot be measured conclusively in Seurat's works, it is easy to follow the line of thought from one to the other.

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11 Goethe, Op.cit., p. 158.

12 Faber Birren, History of Color in Painting, London, 1965, p. 80.

13 Birren, op.cit., 1965, p. 25.

Goethe's powers of observation were keen and his descriptive abilities eloquent, traits which Seurat would have embraced. Goethe also seemed able to hit upon the proper causes for what he was seeing. For example, both his indication of the opposing process, when he divided the visible spectrum into cold and warm colours, and his suggestion that the retina contained the 3 colour-sensing capabilities were reached prior to the work of Hering and Helmholtz.[14] These have been substantiated by further research.

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14 Weale, "Theories of Light and Colour in Relation to the History of Painting", 1974 thesis, 21.

Ogden Rood (1831-1902)

Ogden Rood was an American of Scottish descent who worked originally as a physicist and then as a chemist before becoming interested in physiological optics. His talents as a watercolourist facilitated his practical explanations of light and colour in his Modern Chromatics which he published in 1879.[1] In this book Rood discussed complementary colours, simultaneous contrast, reflected and transmitted light, afterimages, coloured shadows, colour mixtures and the basic theories of colour vision. He echoed many of the ideas of Chevreul and Blanc, correcting them as needed and improving upon them by further scrutiny and controlled experimentation. He also introduced his readers to the scientific findings of Young, Helmholtz, Maxwell and Hering by offering appropriate parts of their research--which he felt would help painters. He believed that some basic knowledge of colour would help artists by alerting them to possible problems while it helped them to better their efforts with colour.[2] Since Seurat was known to have obtained a French translation of Rood's text in 1881[3] and he was also known to have used Rood for reference while he was painting La Grande Jatte,[4] special attention will be given to Rood's ideas.

The first chapter of Rood's book brings attention to the variety of modes of appearance for colour. Reflections from different surfaces, ranging from shiny to dull, and the

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[1] Rood, Ogden L., Modern Chromatics: A Students' Text-book of Color, New York, 1879. The translation into French, Théorie scientifique des couleurs et leurs applications a l'art et a l'industrie, was printed in Paris in 1881.

[2] Birren, History of Colour in Painting, 1965, p. 225.

[3] Russell, Seurat, London, 1965, p. 57.

[4] Birren's introduction to Rood's Modern Chromatics: Students' text-book of color with applications to art and industry, New York, 1973 ed., p. 42.

differences between light which is transmitted versus light which is reflected form the basis of Rood's discussion. The knowledge is basically common-sense, Rood-imentary one might say, although Rood supplements his statements with scientific support. The "science" part of the support is a key facter in Rood's influence over that from Chevreul, Blanc, Humbert or Goethe: Seurat could be assured that what he was reading was empirically supported rather than intuitively believed to exist.

Chapter Three discusses colour constants and makes clear the differences between colour constants for light in the forms of wavelength, purity (freedom from the sensation of white) and luminance (brightness) and the equivalent forms for colour sensation of pigments in hue (colour name), saturation and brightness. Although Rood's discussion becomes very technical in this chapter, the reader should by now be alerted to the fact that there is a very important difference between coloured light and coloured sensations. Rood's technical experimentation in this chapter, and he defined and measured all of his constants, laid the groundwork for a systematic colour order.[5]

Chapters 4 through 7 cover interference, polarization, opalescent colours, apparent colour changes through liquids and flourescence; subjects which are interesting but which would have probably have been beyond most artists' comprehension let alone their ability to replicate those effects in paintings. The reader, or artist, might be tempted to ignore this section and skim on towards a more applicable chapter yet a titbit at the end serves as a reward for the persistent reader. Rood mentions an application of an effect incorporating the differences of light

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[5] Rood, op.cit., p. 35.

reflecting off different surfaces. He cites the fact that while green paint absorbs all red light, the chemical chlorophyll in leaves reflects some red light back. Thus, for a painter to show the reds and yellows from a setting sun being reflected on a yellow-green leaf, he will need to make the leaves look more red than green to be correct in a depiction of foliage.[6] Gems such as these are quietly slipped in and only a concerted effort at reading through all the technical descriptions reveals such a find for the artist.

In Chapter 8 Rood discusses abnormal vision and colour blindness. He was basically correct and present-day research has far advanced his findings; and, the fact that he managed to identify them at all shows his acute observation skills. In Chapter 9, Rood sums up the findings of Young and Helmholtz and discusses Maxwell's discs which show how spinning coloured discs involves a an additive process whereas mixing the same colours in pigment form involves a subtractive process.[7] It is at this point in Rood's writings, where a basic misunderstanding in the Neo-Impressionist theory begins.

The writings of Rood which Seurat read would have made distinct the differences between the primary colours of <u>light</u> and the primary colours of <u>pigments</u> and would have stressed that, "...as paint cannot exactly emulate the qualities of light, the painter should not expect his medium to act in the same way as colour does in natural circumstances."[8] This message reiterated

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[6] Rood, <u>op.cit.</u>, p. 81. Technically, chlorophyll absorbs the photons in the red and blue parts of the spectrum (and converts their energy into food for the plant) while the green photons are reflected. See Trefil, <u>1001 Things everyone should know about science</u>, New York, 1992, entry 375.

[7] The research of Young, Helmholtz, Maxwell and Hering will be examined in greater detail immediately following this section.

[8] Thomson, <u>Seurat</u>, Oxford, 1985, p. 33.

the findings of Helmholtz and Maxwell; yet some artists still strove for a process which would enable them to replicate in paint those effects which were created by mixing lights. Basically, they thought a different painting technique, in addition to an altered palette, would help them achieve their goal by overcoming the differences between light and pigment mixtures.

Next, in Chapter 10, Rood discusses colour mixtures and elaborates upon the information given in Chapter 8. Rood now identifies the pigment primaries as Red, Yellow and Blue, while the light primaries are Red, Green, and Blue-violet; he also explains how one set of primaries can be derived from mixing pairs of the other.[9] Thus, a red and a green light superimposed over one another will yield up a yellow colour, and so on.[10] Rood produced colour triangles to help the artist predict colour mixtures with paint. From a study of the effects of saturation in juxtaposed colours, he developed his colour contrast diagram consisting of 22 pairs of watercolours which sat in direct opposition to their complementary other half; Seurat is known to have copied this diagram and used it as a reference even though he worked with oil paints.[11]

While continuing his discussion on colour mixing, Rood inadvertently provides misleading information for the artists which would not have occurred had he been better acquainted with the work of Helmholtz.[12] Rood's next explanation of colour mixing goes slightly askew when he states that colours mixed with light

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[9] See Illustration 53 for Subtractive colour mixing.
[10] See Illustration 52 for Additive colour mixing.
[11] See Illlustration 1. A copy of Rood's diagram was found amongst Seurat's effects at his death.
[12] Helmholtz's work will be examined in detail in a subsequent section in this chapter.

are precisely the same as colours mixed visually via spinning discs or through some pointillistic technique. Although the resultant colours from each method may look to be the same, the brightness levels obtained from the different methods of mixing colours are not the same.

When one superimposes one light directly over another, the resultant brightness is the sum from each of the two individual brightnesses. Whereas, when colours are spun on a disc or placed side by side on a canvas for the purpose of optical mixing via methods such as divisionism or pointillism, the resultant brightness level is the mean of the two original brightness levels, not their sum.[13]

Although Rood seemed to be thorough in his explanations until this point, he failed to make crystal clear the subtle, yet significant, difference involved in the application of this information. Mixing pigments by spinning, or via individual dots as in pointillism, will create a higher brightness level than palette mixing but it will never equal, duplicate or replicate the brightness level and effects produced by mixing lights. Seurat and his colleagues seemed unable to apply this knowledge clearly and consistently even though a translation of the pertinent text from Fénéon illustrates the point.

> Isolated on the canvas, these colours re-compose on the retina; what we have is not, therefore, a mingling of colours conceived in terms of pigment. It is a mingling of colours conceived in terms of light. I need hardly say that, where the same colours are involved, a mingling of pigments does not necessarily give the same results as a mingling of light-rays. We also know that the luminosity of an optical mingling is always very much greater than the luminosity of a material mingling of pigments.

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13 Rood, Op.cit., p. 131.

> The many equations of luminosity established by M. Rood prove this decisively.[14]

Although Fénéon says that pigment mixing is not the same as light mixing since the results are "not necessarily...the same" to light mixing, he still manages to imply that pointillistic applications of paint produce equal results because the paint's colour is "..conceived in terms of light". While an optical mix is better than a pigment mix, an optical mix is not identical to a light mix even if it is "...conceived in terms of light". Pigment and lights are not interchangable when one is discussing mixing.

Rood then issues the key statements which artists like Seurat must have embraced and held as their motto:

> We refer to the custom of placing small dots of two colours very near each other, and allowing them to be blended by the eye placed at the proper distance.....This method is almost the only practical one at the disposal of the artist whereby he can actually mix, not pigments, but masses of coloured light.[15]

However, as has been discussed, the basic presumption from those statements was wrong; one cannot mix pigments and expect results identical to those from mixing lights since light mixtures are additive and visual mixtures from a spinning disc or dots are medial. Although Rood did numerous experiments which "..proved the superiority of optical mixture of colour over subtractive mix of pigments.." he did not make it crystal clear that optical mixing still was only second best to the additive mixtures of light.[16]

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[14] Russell, Op.cit., p. 181, part of Fénéon's description of the process employed by Seurat in La Grande Jatte. Mr. Russell does not give the original source for this quote by Fénéon.

[15] Rood, Op.cit., p. 139-140. The original work was established by Dr. Jean Mile in 1839.

[16] Rood, Op.cit., p. 146-149.

Therefore, Rood's discussion of mixing 'masses of coloured light', which Seurat naturally extrapolated to include mixing masses of coloured paint spots was misleading: No matter what is done, a surface blend will always be duller than a blend of lights. Granted, what is called the "rationale of divisionism" may not demonstrably be Seurat's rationale. And, although there is no documentation to support that Seurat's idea of divisionism was equated with the direct mixing of coloured lights and, therefore, was equal to the precise addition of their luminosities, the thought is implicit. Seurat's failure to appreciate the difference between optical blending and the "genuine addition of coloured lights", was crucial and Lee believes that "...this rationale of divisionism depends on misconstruing scientific discoveries about the nature of light and the perception of colour."[17] Thus, a strict application of Rood's concepts meant that Seurat's theory became flawed.

Regardless of a flawed theory, critics and supporters alike spoke of greater luminosities being a desired goal for the Neo-Impressionists; they certainly did not and, perhaps, were not capable of differentiating between medial (greater) or additive (greatest) luminosities. If Seurat wanted to obtain effects as close to those of light as possible, then the qualities of lustre and the "flicker" were his more realistically attainable goals. A quote from Fénéon supports this supposition:

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[17] Alan Lee, "Seurat and Science", Art History, June 1987., p. 210. Lee offered a possible explanation: The version of Rood's text which Seurat would have seen had a colour plate illustrating the differences between mixing lights and mixing pigments. If someone with a high visual-orientation had focussed on the illustrations and skimmed the text, it might be possible to misinterpret the drawings. Only a thorough reading of the text, would have revealed the key differences. Furthermore, Lee sees Rood's findings in their entirety to be "...a vindication of traditional practice." p. 211. The message from Rood, Lee believes, is to stick with the palette. I disagree.

> Perhaps this sensation, which is also experienced in front of other paintings in the same room, can be explained by the theory of Dove: the retina, expecting distinct rays of light to act on it, perceives in very rapid alternation both the dissociated colored elements and their resultant color.[18]

Viewers had spoken of the vibration and the flicker which was visible in of some of Seurat's newly finished canvasses. "Lustre" was the name given for this sensation which was first identified by the German physicist, Dove, under whom Rood had studied for a while. A certain brilliancy is produced "..when two masses of light simultaneously act on the eyes, lustre is perceived, provided we are in any way made conscious that there are actually <u>two</u> masses of light..."[19] If Seurat believed that his spots of paint were reacting like spots of light, it would be logical to presume that this lustre, or increased brilliance, would be an added benefit. There is a point just before optical mixing occurs where the colours are imperfectly mixed "...so that the surface seems to flicker or glimmer--an effect that no doubt arises from a faint perception from time to time of its constituents."[20] Furthermore, since Seurat was able to achieve the effects of lustre, he probably took this as affirmation that his basic approach and theory were correct and that it was only his materials and developing technique which prevented him from achieving even greater levels of luminosity.

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[18] Fénéon, from "Les Impressionistes en 1886", <u>La Vogue</u>, June 13-20, 1886, in Rewald, <u>Seurat: A biography</u>, London, 1990, p. 107. Rewald states that this brochure was significant not only because it offered the first analysis of Seurat's art "but in emphasizing the triumph of system over intuition, it also presaged the dissolution of the Impressionist group." (109)

[19] Rood, <u>Op.cit.</u>, p. 280.

[20] Rood, <u>Op.cit.</u>, p. 280.

19th Century Scientific Colour Theory Research

We have examined the theories of Chevreul, Blanc, Humbert de Superville, Goethe, and Rood before assessing the impact their ideas had on Seurat. Although the research of these men, and those who will be discussed next, all occurred during the 19th century, they have been grouped in this way because of their orientations and backgrounds.[1] The theories of "The Real Scientists"; those researchers who had formal training in one or more scientific disciplines and their direct impact on Seurat's thoughts cannot be quantitatively measured. However, they, like the others already discussed, all helped to influence and guide the research and thought of the time; and research on colour, in particular, cannot be ignored when considering Seurat's mental milieu.

As we have stressed before, there can be no absolute certainty that Seurat studied any of Helmholtz's writings; the likelihood is high, though, since Rood mentioned Helmholtz while also corroborating the findings of Young and Maxwell. Rewald states that Dubois-Pillet was the first to apply a systematic divisionism to portraiture but, when he became dissatisfied with the writings of Rood, he turned to the work of Young for more specific and detailed guidance of the visual process.[2] If Dubois-Pillet exercised enough initiative to investigate Young, the likelihood is that Seurat would have done the same. It would be

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[1] Rood was trained as a physicist and chemist, and had a great interest in physiological optics, his publication was aimed toward artists who would not have the background to understand "heavy science". Although Rood backed up his findings with experiments, his work, I believe, is less stringently controlled than the work discussed in this section--hence Rood's inclusion with the first lot. No slight towards Rood is meant or implied.

[2] Rewald, Post-Impressionism, 3rd ed., 1978, p. 109. Dubois-Pillet must have begun investigating the 1807 work of Thomas Young around 1886-87. It would seem highly probable that Seurat would have been appraised of this line of investigation as well.

unlikely for someone like Seurat, someone who so fiercely guarded his central role in this movement and someone who was open to scientific input, to be unaware of work, discussions, and investigations being done by any of his followers or companions.

We do not know if Seurat had even heard of Hering, let alone perused his writings but the writings of Goethe, Blanc, and Humbert were so similar in inclination to Hering's, and anticipated his findings so well, that it would have been logical to continue the process. Since Seurat had studied the "pseudo-scientists", one might suppose he would have been inclined to study more scientific findings. And, since Helmholtz and Hering were locked in a researcher's battle, each publishing his findings in refutation to those of the other, one could further surmise that the name "Hering" and his ideas were at least known to Seurat. Further, Hering's ideas are an important adjunct to the core of Helmholtz's findings and are, therefore, both necessary to set the stage for 20th century research.

In the nineteenth century, there was much controversy regarding understanding and defining the visual process. The type of stimuli entering the eye is constantly changing, the state of the eye itself is changable, and the functioning from the eye to the mind varies with the "mind set" and the training of the person. Trying to describe what "vision" is and what is involved in the entire process is something which is to this day still being clarified in the higher neural stages of visual processing.

Vision is profoundly affected by the condition of the retina at the moment of stimulation. The condition of the retina of any given part is determined by temporal and spatial factors. The

temporal factor concerns the nature of the stimulation to which the retina had previously been submitted. For example, bright light conditions will have a carryover effect on viewing in subsequently less intense lighting conditions. The spatial factor concerns the reciprocal action of different areas upon each other. In other words, the excitability of a given area is affected by the condition of sensibility and stimulation of the surrounding areas.[3] This is the sense of vision from a physiological viewpoint.

Defining vision, light and colour from a psychological aspect becomes more difficult. The psychological aspects of "colour" depend upon the sensations aroused by the physiological processes which are set into motion by the physical stimuli. One cannot dissociate the physiological aspects from the attendant psychological aspects for that very act of analysis is a psychological process.

We tend to describe objects in terms of our visual impressions of them: Long, red, round, smooth, dented, and so on. These descriptions are subjective and need to be dissociated from the physical stimuli which give rise to them. When we try to describe "colour", in anything but a subjective manner, we are attempting a difficult, if not nearly impossible, task. Hering coined a term for our propensity to attribute a colour to the object being viewed; this tendency is maintained even under drastically changing lighting conditions; we still see grass as being green, for example, even when our light source is bright red.[4]

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[3] Hershberger, Perception lecture, Northern Illinois University, 1982.
[4] Hering called this "Gedächtnisfarbe" translating as "memory colour". Our memories of colours are so strong, and so ingrained, that they can override

Scientists have words to describe the physical and psychological aspects of a visual stimulus. It would seem logical, then, that the psychophysics of colour could be explained through simple empirical relationships between the physical and psychological aspects. However, this fails to happen. Different categories of light energy will give rise to different visual sensations because, for example, light from a source is dissimilar to light from an opaque or transparent surface. Thus, for example, physical light energy becomes transformed to a luminous quantity, the intervening construct, before it may be interpreted as the quality known as "brightness".[5] Visual research has failed to correlate visual stimuli to visual sensations directly.

Finally, there needs to be a clear idea of what is meant by perception versus sensation. We have already noted the interest shown in the mid- to late-19th century regarding what is perceived versus what is known; scholars at that time were aware that these processes were inter-dependent though they were not necessarily able to define the degree of dependence. Perception may be defined as the meaningful interpretation of sensations; as such, it is an internal representation of an external object.[6] Sensation depends upon the sensory nerve stimulated; it is a physiological process and the optical nerve is what produces our visual sensations. A visual sensation is, therefore, an internalized event separate from the object being viewed and is

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actual physical evidence to the contrary. See K. von Fieandt, The world of perception, Eng. adaptation, USA, 1966, p.86.

[5] Hershberger, Op.cit., 1982.

[6] Schiffman, Sensation and Perception: An integrated approach, New York, 1976, p.

often described in terms of intensity, quality, and duration.[7] Thus, one may perceive a coloured object but only sense its colour.

So, whether colour is a sensation, a mental phenomenon, a physiological event or a concept, is arguable. For Seurat, colour was a tool and a means of expression; manipulating colour, especially under the approved research findings of the time, could further his control over colour and clarify his meanings. With these thoughts in mind, we turn now to the research of Young, Helmholtz, Maxwell and Hering to see how their findings could have shaped Seurat's approach to his art.

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[7] Hershberger, Op.cit., 1982.

Young-Helmholtz-Maxwell Trichromatic Colour Theory.

Determining the primary colours in pigments was of great interest for artists since they needed to know the fewest possible colours required to make another in order to keep their works fresh and bright. Scientists, on the other hand, needed to determine spectral primary colours in order to further their understanding of light and its effects as it impinged upon the eye and then traveled to the brain. In 1802 Thomas Young (1773-1829) proposed that there had to be a limited number of sensitive points on the retina which could be activated by a particular wavelength of light; subsequently, he identified three different kinds of colour sensations as being red, yellow and blue.[1] Upon reconsideration, however, he adjusted the colours to red, green and violet just one week later.[2] Young further supposed that there was a corresponding set of nerve fibres in the fovea of the eye which would prove maximally sensitive to each of the three colour sensations and a colour not of the original three would be represented by a combination formed from the three receptors in a determined ratio.[3] Thus, the whole range of light could be perceived by the three kinds of receptors.

This was based upon the assumption that for daylight vision there were sensitive receptors called cones which were "..capable of mediating three, and only three, independent and distinct

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[1] See Sherman, Colour Vision in the Nineteenth Century: The Young-Helmholtz-Maxwell Theory, Bristol, 1981, p. 10 for a discussion on Young's 1802 lecture "On the theory of light and colours", Phil. Trans. R. Soc., 91.

[2] Birren, History of Color in Painting, 1965, p. 30. Young took over the three primaries as identified by Wünch and "...passed them on to James Clerk Maxwell and Hermann von Helmholtz--and subsequently to A.H.Church and R. A. Houston of England, Wilhelm von Bezold of Germany, and Ogden Rood, Michael Jacobs, and (to some extent only) Albert Munsell in America." p.30

[3] James Southall, Introduction to physiological optics, New York, 1937, p.340.

elementary or primary colour sensations."[4] Thus, a primary colour would result in the selective stimulation of only one of the sets of receptors.[5] Through a series of experiments, Young determined the proportion of the primaries required to produce white to be 7:6:5 for red, green and violet, respectively.[6]

Scientists did much work with prisms to determine the primary colours yet, no matter how great the dispersion obtained in the spectral display was, for the next 20 years researchers remained in disagreement over yellow. Whether yellow was an independent primary colour or a combination of two colours remained unresolved since they were unable to produce spectral colours which were defined clearly enough to analyze the yellow. In 1822, David Brewster began experiments with filters intending to find one which would absorb each end of the spectrum in order to leave the middle (and yellow) part free for analysis; "thus attenuation of the light was effected while difficult focusing due to chromatic aberration in the eye was reduced by eliminating the extreme ends of the spectrum".[7] Brewster ran these experiments under the assumption that "light of all three

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[4] Southall, Op.cit., p. 339.

[5] Southall, Op.cit., p. 340. Hecht (J.O.S.A., XX, 1930, p. 232) points out that so far as vision is concerned Young's hypothesis of three primary colour sensations was really an anticipation of J. Müller's doctrine of specific nervous energy, according to which any nervous receptor invariably excites a characteristic sensation peculiar to it, no matter how it may be stimulated. For example, when a "red" fibre or cone is aroused, regardless of whether the luminous radiation is homogeneous or not and irrespective of the wavelength of the light, the nature of the response is always the same, namely, red. According to Young's theory, the quality of a colour sensation depends on the ratios of the intensities of the three primary sensations that are involved, whereas the brightness of the colour is measured by the sum of these intensities.

[6] Sherman, Op.cit., p.14. Although Young's experiments to determine these ratios comprised spinning discs (an additive process) and mixing powders (a subtractive process), he surmised that pure white would be obtained if the light were bright enough. He did not realize the differences between the colour mixing processes--it took Helmholtz to sort that one out--yet reached the correct conclusion neverthless.

[7] Sherman, Op.cit., p. 23.

fundamental colours could be proved to exist in the different simple colours by the absorption of light by coloured media."[8] Though it is not necessary to go into the details of Brewster's work for the sake of this research, he was able to correctly identify yellow as being independent in the spectrum.[9] However, and quite surprisingly for a man of his competence, Brewster caused a good deal of confusion when he extended his findings of three primary colours into his triple spectrum theory. Thirty years later, it took the genius of Hermann von Helmholtz (1821-1894) to clarify the confusion created by Brewster's research on primary colours.

Through a series of ingenious experiments in 1852, Helmholtz was able to prove the minimal number of spectral lights which could be combined to create white, a bonus of which was the refutation of Brewster's triple spectrum theory. The experiments involved shining light through pre-determined slits in a board before diffracting it through prisms, and the three basic set-ups Helmholtz used were as follows:

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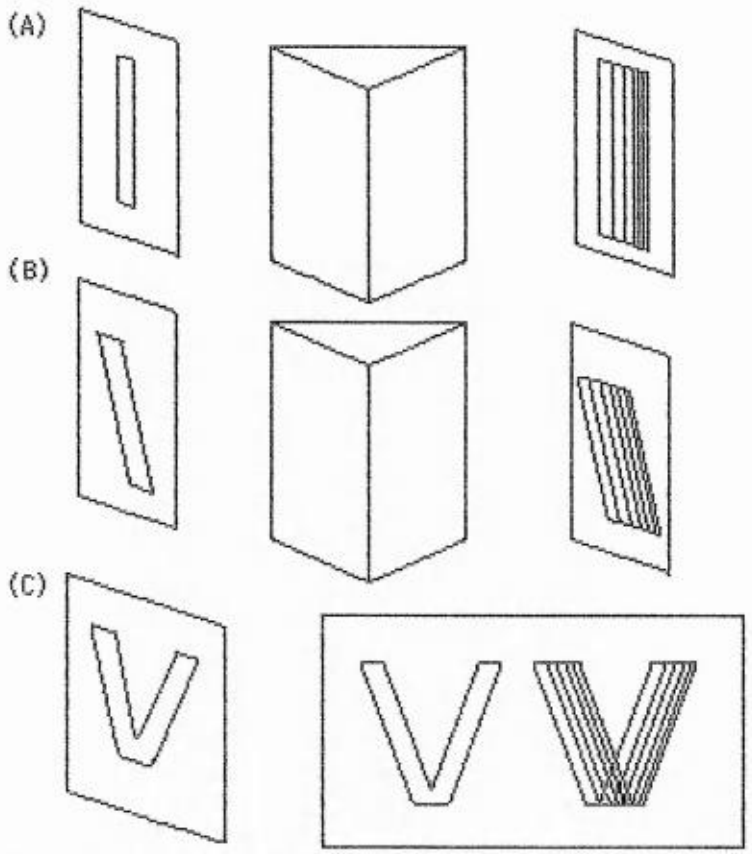
[8] James Southall, ed., Helmholtz's Treatise on Physiological Optics (trans. from 3rd German ed.), Vol. II: The Sensations of Vision, USA, 1925, p. 142.

[9] Brewster invented the kaleidoscope, discovered phenomena concerning refraction and polarisation and was awarded numerous honours as one of Europe's leading optical researchers. See Sherman, Op.Cit., p. 20-42 for more information on Brewster's background and how his triple spectrum theory ground colour vision research to a halt.



Slits, prism and resulting spectra based on descriptions by Helmholtz

Helmholtz was able to determine every possible binary additive combination of wavelengths of spectral light by this elegant experiment. First, he viewed the vertical slit through a vertically-situated prism to produce a rectangular spectrum; next he viewed an oblique slit (cut at 45 degrees to the horizontal) through a vertically oriented prism which produced an oblique spectrum whose bands were parallel to the slit; and, finally, he viewed two oblique overlapping slits (which were joined together to form a "v") which produced spectra which overlapped and intersected at right angles. This produced every possible colour combination with the overlapping spectra and "...thus we at once obtain the total combinations capable of being formed out of

every two simple colours."[10] Through this experiment Helmholtz was thus able to provide definitive experimental observations which refuted the mistaken belief that yellow and blue lights, for example, would produce green; with this experiment, they produced white from their additive mixture rather than the expected green which results from the subtractive mixture of pigments.

Thus, in 1852, not only had Helmholtz shown support for Young's spectral colour research by similar findings of his own, he had clarified the state of colour research while providing the physiological plausible evidence for what was to become known as the Young-Helmholtz Trichromatic Theory.[11] He postulated that, from the three identified receptors any colour could be obtained; white was the aggregate of all colours; black was the absence of any light; and gray fell somewhere in between. The three receptors are maximally sensitive to one colour (red or green or violet) but are responsive to all wavelengths. While Helmholtz agreed with Young's identification of red, green and blue-violet as the spectral primaries, his further, much more specific, and replicable experiments with light filters and prisms provided stronger corroboration for those choices. Thus, until Helmholtz's time and the findings of his experiments, colour

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[10] Sherman, Op.cit., p. 83. This experiment was originally reported in Helmholtz's "On the theory of compound colours", Ann. Phys., Lpz. 9. (English translation published 1852 Phil Mag., IV.)

[11] It should be noted that the word "trichromatic" causes some agitation on the part of Christine-Ladd Franklin. She feels that it is misleading and that "the vision of the totally chroma-blind is not monochromatic but achromatic. The initial three-fold photo-chemical process which actually takes place in a cone should be called a tri-receptor process." This objection is cited in Southall's 1924 edition of Helmholtz's Treatise on Physiological Optics, Vol. II, appendix, p. 464. In an effort to avoid further confusion, we take note of her valid objection but will continue to use the phrase "Trichromatic" since that is the one that has been used more rigourously.

perception had been a descriptive science which was more speculative than exact.[12]

During the years from 1855 to 1866, Helmholtz published a series of three volumes entitled Handbook of Physiological Optics.[13] The sections on vision contained accurate descriptions of colour fundamentals, some astute observations on physiological optics which would lead into beneficial research, and thoughts on the nature of colour relationships within both light and pigment situations as well as between the two. Both this series of books and Helmholtz's 1881 Popular Lectures on Scientific Subjects were of great interest to 19th century artists because he tended to emphasize the nature of perception in his discussion rather than the object being perceived.

During the late-19th century Helmholtz gave a series of lectures in Cologne, Berlin and Bonn on scientific topics which were geared towards anyone without a specialist background or specific scientific training. One of these popular lectures, his "On Relation of Optics to Painting", would have been of great interest to Seurat because it covered areas of form, shadow, colour and harmony of colours.[14] For example, in terms of lighting values he correctly identified that colours changed with illumination and indicated how an artist should put in more yellow tints to show bright sunlight and more blue tints in paintings showing moonlit settings.[15] Helmholtz also affirmed

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12 Sherman, Op.cit., p.xii.

13 Hermann von Helmholtz, Helmholtz's Treatise on Physiological Optics: Vol. I; Vol. II: The sensations of vision; Vol. III: Perceptions of vision; all three 1860 original publications were translated in 1924 to English by J.P. Southall, Ed. Wisconsin, USA: The Optical Society of America. (from their 3rd German editions of 1909, 1911 and 1910 respectively) .

14 Hermann von Helmholtz, Popular Lectures on Scientific Subjects, trans. and second series, London, 1900.

15 Helmholtz, Popular Lectures on Scientific Subjects, Op.cit., p. 98 and p. 112.

that successive contrast is of vital consideration for painters because people will look at one colour and then another; good painters can enhance this natural phenomenon by putting a yellowy edge around a gray object which is in front of a blue background, for example.[16] This suggestion not only echoed the reports of Chevreul from 40+ years earlier, but it also supported--in theory--the actual physical application of contrasting paints which Seurat had employed 7 years earlier.

Another issue which Helmholtz investigated concerned differences in illumination. Helmholtz expanded upon the 1860 work of Gustav Fechner which dealt with the relationship of sensory magnitude to physical magnitude.[17] For the perceived changes in brightness due to varying illuminations, Helmholtz said that "Within wide limits of brightness, differences in the strength of light are equally distinct or appear equal in sensation, if they form an equal fraction of the total quantity of light compared."[18] In layman's terms that means that when illumination varies, the perceived brightness varies by the same proportion of its total value. Helmholtz also noted that very high luminosities made everything look white; an observation first noted by Newton but which was virtually ignored until 1853 when both Helmholtz and Grässman, the mathematician, investigated the issue again.[19] These findings would have been of great

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16 Helmholtz, Popular Lectures..., p. 120.

17 Gustav Fechner, The Elements of Psychophysics, Germany, 1860 as discussed in Schiffman's Sensation and Perception, New York, 1976, p.15-16. Fechner's Law used a standard unit to measure the subjective magnitude of sensation and stated that as all sensory units increase arithmetically, the stimulus intensity increases geometrically.

18 Helmholtz, Popular Lectures..., p. 101.

19 Sherman, Op.cit., p. 56.

interest to artists since, once again, they provided scientific support for what had hitherto been subjective observations.

Helmholtz was a key person in changing the way of scientific thinking in the mid-1800s. He was a meticulous worker and refused to accept any scientific findings without first replicating them for himself. Consequently, his results were taken very seriously in the world of science and by the few artists who studied him. In fact, it has been claimed that Helmholtz "had a significant influence on the development of impressionism" by his firm identification of the way coloured lights function differently from coloured pigments--though direct evidence for this influence is not readily available.[20]

Most importantly for our discussion, also in 1852, Helmholtz clearly identified the differences between subtractive and additive colour mixing.[21] The emphasis is on the clarity of Helmholtz's research since, although others had identified the differences, Helmholtz was the first to unambiguously define the qualities of light vs. pigment mixing as he also outlined their relationships.[22] Thus, the colour primaries in light, or those determined as the basis for additive mixing are: red, green, and blue. The colour primaries in pigments, or those determined as the basis for subtractive mixing are: magenta, cyan, and yellow.[23] A combination of two of the additive primaries will

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[20] Warren and Warren, Helmholtz on perception: Its physiology and development, New York, 1968, p. 137.

[21] See Illustrations 52 and 53.

[22] J. C. LeBlon, identified the primaries in a publication sometime in the late 1720s and correctly pointed out the reciprocal relationship between additive and subtractive mixtures around 1756. See Birren, History of Color in Painting, New York, 1965, p. 25.

[23] While Helmholtz identified cyan (a bluish-green) as the complement to red, Rood thought the complement was a green-blue instead. Rood reached this conclusion using newer equipment than Helmholtz had; Rood also used two eyes for his experiments while Helmholtz had used just one. Using two eyes may have made some difference in that one eye is always slightly better

produce a subtractive primary. In other words, the "negative colours" of those used for addition are the colour primaries for subtraction and vice versa:

Additive Primaries:	Subtractive primaries:
Red	Cyan
Green	Magenta
Blue	Yellow

The main difference between additive and subtractive colour mixing may be explained as follows. When mixing a monochromatic yellow light with a monochromatic blue light on a screen, the photons (light particles) reaching the eye are a combination of photons from both the yellow and the blue parts of the spectrum. The photons are thus added and the result of such an addition depends upon the relative numbers of the photons and the probability that they will be absorbed by the each type of receptor in the eye.

Subtractive colour mixing, however, is the process inherent in the mixing of paint pigments. One pigment will absorb its complementary colour--a yellow will absorb blue and vice versa--while reflecting its own colour. When two pigments are mixed, more light is absorbed with less light being reflected; further pigment mixtures result in less and less light being reflected; hence, the muddiness of colours when too many pigments are combined. Again, though, the final perceived colour depends upon the relative absorption rate of each of the receptors in the eye.

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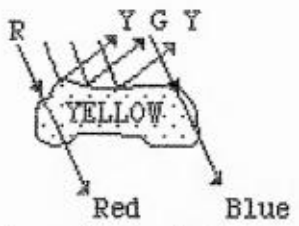
suited to "reading" distance while the other is better suited to "reading" close proximity; this means that one eye sees greens and blues more sharply while the other does better with reds--this may have been the reason for the slight differences in colour identification between Helmholtz and Rood.

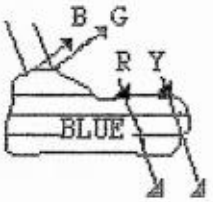
Paint mixing: YELLOW + BLUE = GREEN

Why?

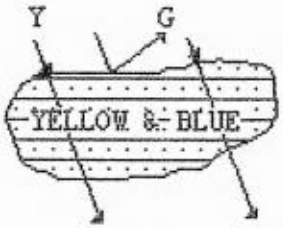
YELLOW is this:



BLUE is this:



Mixed together yields:



When these two paints are mixed together, the reflected yellow becomes absorbed by the blue and the reflected blue becomes absorbed by the yellow. Green is present because photons from the green portion of the spectrum are the predominant photons in the light reflected by the mixed paint. So, in effect, the blue and yellow light are both subtracted from the white light by the mixture and the remaining reflected light is green in colour.

Proof of the colour primary choices by Young-Helmholtz was shown in a novel experiment by James Clerk Maxwell (1831-1879) in 1855. He photographed one scene with black and white film, three different times, from the exact same position, but only changed the colour of illumination from red to green and then to blue. The film was then developed and positive black and white transparencies were made. Each of these three transparencies was then put into one of three projectors with a filter corresponding

to the transparency's original colour; that is, the scene with the "red" positive B/W transparency was projected through a red filter, and so on. When the three images were superimposed, one on top of the other, the result was a stunning colour projection of the original scene with all of the colours, tints and shades in their original places! Although Maxwell found that adjusting the brightness levels of the primaries tended to produce better results--since some degree of brightness inevitably was lost during the photographic processes--he took his findings as definite support for the Young-Helmholtz trichromatic theory.[24,25]

Maxwell's innovations with spinning tops enabled him to supercede experiments done by Helmholtz. Spinning tops with colours painted on in predetermined proportions on top had been used for years by scientists to display how colours blended together. However, rather than use such painted tops, Maxwell used circular pieces of coloured papers which slotted together through each other's radial slit. The coloured papers not only ensured a constant and regular colour, they also enabled him to precisely control the proportion (out of 100 units) of each colour being blended. A further innovation of smaller circles of black and white enabled him to provide a means to measure and match the brightness levels.[26]

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[24] Hershberger, Op.cit., 1982.

[25] Fieandt, Op.cit., p. 96. An interesting sidenote: In 1959, Edwin Land photographed a still life twice on B/W film. The first was taken through a red filter for the long wave record and the second was taken through a green filter for the short wave record. A similar procedure to that followed by Maxwell was undertaken. Even though Land had used only two original colours, a final full range of colours was obtained. This implies that wavelengths are not precisely colour-making per se and that the eye assigns particular colours to complete the image most accurately. See Edwin Land, "Experiments in color vision", Scientific American, May 1959, for more details.

[26] Sherman, Op.cit., p. 159-160. The black and white portions allowed Maxwell to employ Grässman's equations of colour in which required matches were made by known intensities of light. Ibid., p. 161.

Maxwell's spinning disc set-up. Two different coloured pieces of paper, with slits on a radius, were slotted together. The final, spun colour was identified by the precise proportions from the two original colours.

With his primary colour choices of red, green, and blue, Maxwell showed experimentally how any three colours could be used as primaries and how their product could be specified.[27] This research seemed to support and extend that of Young and Helmholtz with their chosen primary colours, and matching receptors, of red, green and a blue-violet. Now that the basics had been determined, and apparently proven by the Young-Helmholtz-Maxwell Trichromatic Theory, it only remained for the further visual pathways to be examined.

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27 Sherman, Op.cit., p. 220.

Hering's Opponent Process Theory

The general thrust of science in the mid-nineteenth century was concerned with the analysis of single independent and dependent variables which implied simple stimulus-response actions; anything beyond this concept of "A" triggering "B" was attributed to mental interpretation or intervention, whether from the subject or the investigator it did not matter enough to be considered.[1] Scientific research at that time was not able to cope with, nor willing to consider the possibilities of more complicated relationships involving multiple simultaneous events.

Ewald Hering (1834-1918) was a nativist who believed that all behaviour was determined by physiological mechanisms; he had little time for such concepts as "mind", "inference", or "judgement" nor would he give scope to any input or interference beyond "A" triggering "B" from such items. He had trained as a physiologist under Weber, studied zoology and medicine and had the benefits from his training under the anatomist Fechner.[2] His varied background combined with his keen mind and precise research methods often produced findings which ran contrary to contemporary nineteenth century scientific thought; yet, more often than not, his findings were vindicated--even if it took one hundred years or more for the rest of the world to catch up with him![3]

If Hering were to formulate a definition of the colour process, basically it would read as follows: colour is a function of a light stimulus and is dependent upon 1) the nature of the

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[1] Hering, Ewald, Outlines of a Theory of the Light Sense. Translated by Leo M. Hurvich and Dorothea Jameson, Cambridge, 1964, p. ix.
[2] Hering, Op.cit., p. ix.
[3] Hering, Op.cit., p. xii.

affected parts of the brain and 2) the character of the nervous system.[4] Hering placed great emphasis on the neurological involvement in colour and constantly criticized Helmholtz's stress on learning and physical factors. In fact, one could go through Hering's writings and find an almost point-for-point disagreement with each of Helmholtz's notions; not surprisingly, similar written conflict exists whenever Helmholtz mentions Hering.

Although Hering and Helmholtz were in conflict regarding perceptual processes, each of their theories has its adherents and each, in fact, is correct when it is applied to specific portions of the process in the visual system. In the visual process, once the signal moves beyond the receptor level, or that as explained by the Young-Helmholtz Trichromatic Theory, the neural level of functioning, as explained by Hering's Opponent Process Theory, becomes activated.

Hering's Opponent Process Theory of 1876 stated that, since one cannot physically experience a reddish-green or a yellowish-blue, there must be more at work in the visual process than the trichromatic receptor colour theory suggests. In fact, Hering disagreed entirely with the primaries as identified by the Young-Helmholtz Trichromatic theory. Furthermore, Hering felt that the only explanation for colour perception must involve some antagonistic neural organization because one can't "see" yellow-blue.[5] Such a set-up suggests an either/or relationship when neural excitation of blue precludes the excitation of yellow and

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[4] James P. C. Southall, Introduction to Physiological Optics, New York, 1937, p. 296.
[5] B.R. Wooten and J.S. Werner, "Opponent Chromatic Mechanisms Predict Hue Naming" in Frontiers in Visual Science, Vol. 8, New York, 1978, p. 166.

so forth. Like a light switch, the system is either "on" or "off"; there are no in-betweens.

Hering identified three distinct processes in colour perception, each of which was capable of two opponent modes of reaction for visual perception; these processes affected both the brightness levels perceived as well as the hues.[6] Hering's three pairs of antagonistically-related primaries at the neural level are: blue/yellow, red/green, and black/white. Although Hering's theory was attacked in its infancy for the notion of the black-and-white construct, it gained more support with time. With the exception of the black/white pairing which can maintain equilibrium, there are no intermediaries in his theory and one must go across the colour wheel to find the other side of the colour pair; this proves that the coloured-pairs are mutually exclusive; one cannot have aspects of both.

Although the B/W aspect was primarily responsible for brightness, Hering also believed that both the R/G and the Y/B aspects contributed to brightness. Moreover, the R/G and Y/B chromatic systems contributed not just in an additive manner but "...warm responses had a specific brightness and cool chromatic responses had a specific darkness."[7] Since brightness varies primarily with the amount of white or black, corresponds most closely to the physical intensity of the light and, depends upon the given hue, some appear "brighter" than others.[8] Specifically, red, yellow and white have an intrinsic brightness while green, blue, and black have an intrinsic darkness; even

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[6] Hering, Op.cit., p. xiv.

[7] G.S. Wasserman, "Brightness Enhancement and Opponent-Colors Theory", Vision Research, Vol. 6, London, 1966, p. 693.

[8] Gerard Murch, Visual and Auditory Perception, New York, 1973, p. 37.

though the hues may be of equal clarity, they will not "appear" equally bright.[9] Brightness then, for Hering, was dependent upon several factors and triggered both a physiological response as well as a psychological or emotional response. This may be why Seurat's addition of white seemed such a logical step; it turned out to have some scientific validation afterall.

As mentioned in the section on the subjective nature of trying to identify colours by name, it was Hering who was the first to note that surface colours remain unchanged to an observer despite changes concerning the illumination; for example, someone wearing rose-tinted glasses will still perceive grass to be "green". That is, there is a perceptual tendency for the colour most consistently seen and associated with an object to become a fixed property of the memory image--even under different viewing conditions.[10] This concept echoes perfectly the notion of "local colour" which the Impressionists were trying to overcome; they had been trained to see "green" grass but now had to depict what they "really saw", rather than the colours as they perceived or sensed they should have been. This is why it is difficult to explain via a physical stimulus-reaction procedure why we are sometimes unable to assess the proper signals from the eyes when the mind is determined to see what it expects to "see".

One of the more persistent ideas which has arisen from Hering's theory is the notion of dichromatic fovea effect under certain circumstances. This is the reduction, in normal color

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[9] Hering, Op.cit., p. 63.

[10] Hering, Op.cit., p. 7, and Kai von Fieandt, Op.cit., p. 86. This concept, briefly mentioned in Chapter 2, is followed up in Chapter Six where, to date, research shows that there is still some degree of influence of "memory" on colour. Physiological and neurological functions alone cannot account for 100% of a colour's appearance.

vision, of yellow-blue discriminative capacity either at very low light levels or when the stimulus level is reduced by greatly reducing the size of the stimulus field. If Hering's theory is correct on this point, then the degree of illumination, colour of Seurat's dots and, most importantly, the size of his dots, will affect the extent of optical mixing. Although this effect is often misinterpreted to indicate "blue blindness" of the central fovea, the factors indicated above will serve as crucial agents in the optical mixing formula.[11]

For now, the Young-Helmholtz Trichromatic theory functions best at a lower (retinal) receptor level of visual processing and Hering's Opponent Process theory functions best at a higher neural level of visual processing. Strangely though, the fulcrum of the controversy between The Trichromatic Theory and The Opponent Process Theory is yellow; whether yellow is a primary colour or results from a mix of two primary colours has yet to be proven.[12]

Even so, Hering's theory is compatible with and, indeed, requires, the Young-Helmholtz concept of differentially sensitive photopigments. Hering claimed that the perceptual organization of hues seemed to demand matching organization in the neural sense; there were "...reciprocal physiological interactions to handle perceptual effects".[13] Hering's "...physiological discoveries support nicely a theory which was based initially on

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[11] These aspects of vision, and how the eye functions and disfunctions, will be discussed in Chapter Six.

[12] Young et.al. believed yellow to be a resulting colour which was formed by a dual triggering of both the red and green photoreceptors. Hering, on the other hand, believed yellow to the other half of the yellow-blue "switch". Though these two theories address different stages within the visual system, the sensation of "yellow" is the same.

[13] Hering, Op.cit., viii.

psychophysical data."[14] He didn't believe that there was a one-to-one correspondence between the receptors and the neural sensors but rather that all activity depended upon the existing state of each receptor and the the activity surrounding it. there was an inter-relationship within the independent units.

If this is indeed the case, then Seurat would have had to have provided correct information for the visual system to function at its best. Not only would the degree of illumination have to be controlled, but the colours of his paints would have to be "correct" in order to trigger the waiting photoreceptors as defined by Young-Helmholtz. If Seurat had proven lucky enough to meet these requirements, then the size of his paintstrokes would affect the colour's outcome in the neural part of the visual system as described by Hering. It is obvious that the "Ifs" are beginning to build up in this argument, and this is before we have considered the conditions of the materials used and the condition of the viewer's mind/receptiveness to the formula. However, before we judge Seurat's goal to be too improbable, we need to recall that the above findings were new and basically unchallenged; 20th-century science is still assessing the veracity of some 19th-century work. Perhaps Seurat's mixture of intuition with a smattering of science helped him to unwittingly achieve the visual effects he desired. A look at some more aesthetic influences on Seurat will preface our investigation of his later works when, ideally, some of these questions will be answered.

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[14] P.C. Dodwell in Carterette & Friedman, Handbook of Perception: Vol. V: Seeing, New York, 1975, p. 59.

Aesthetic Influences

Kermit the frog sings a song which opines, "It's Not Easy Being Green" and tells the world of his sad state. We can paint the town red, see pink elephants after imbibing one too many and suffer a blue Monday as a result. If someone is happy and healthy, he is feeling "in the pink". Conversely, gloominess and depression fall under the label "black mood". The English language has a glorious profusion of such colour descriptions which have become so imbedded over time that to change the colour in the phrase would go against the grain of the accepted psychological and emotional connotations. After all, who would paint the town blue, see an orange elephant or suffer a sunshine yellow fit of depression? Such notions are absurd and the results comical.

The development of such ingrained associations between colour and moods seems to have evolved from universal and age-old experiences. Rather than entering into a Jungian discussion or becoming embroiled in the Nature vs. Nuture argument in an effort to explain these effects, I would like to offer some valid and verified instances where colour and mood/emotion seem to have become inextricably linked before I discuss how Seurat came to be influenced by such an approach.

People with no colour vision are unable to experience the visual part of such colour phrase associations even though they can hear the phrase and glean the meaning from the context of the conversation. But, do they really understand, can they really comprehend the association? There are documented cases of blind people who have regained their vision through surgical procedures but who have been unable to cope with the onslaught of colour let

alone the more complex visual aspects of motion and perspective. One person had to describe his first glimpse of the colour yellow as lemony, sharp and bitter, since he had to rely upon his senses of smell and taste to describe the virgin territory of his vision.[1] We do not know if that person, or others in his position, after a suitable period of adaptation and training, would eventually come to accept the emotional and psychological associations of a black mood or a blue Monday.

Although somewhat similar to this first example, the second one, synesthesia, is a documented, albeit somewhat rare, perceptual phenomenon. Affecting only 10 people in 1 million, synethesia causes the five human senses (touch, sight, hearing, taste and smell) to become joined together in new and unusual combinations when fragments of perception become attached to a sense to which they are not normally associated.[2] For example, one of the more common synesthetic pairings is coloured hearing where music, noise and voices elicit geometric colour patterns and washes around what is being viewed. One person sees--six inches from her nose--gold balls falling, shooting lines and triangles resembling shards of glass whenever she listens to music.[3] Recipes may be cooked and food eaten on the basis of the shapes of flavours, synesthetes may enjoy talking to one person over another because of a better tasting voice, letters can be shifted at will between the words they form and the colours they

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[1] Annie Taylor, Pilgrim at Tinker's Creek, Bantam Books, 1974, p. 27. Dillard cites several cases from a book by Marius von Senden called Space and Sight the further information of which is not provided.

[2] Dr. Richard E. Cytowic, The Man Who Tasted Shapes, Tarcher/Putnam, New York, 1993. In his 10-year study of synesthesia, Dr. Cytowic, a neurologist in Washington, D.C., has identified over 30 possible links between the senses.

[3] As reported in a review of Dr. Cytowic's book in The Chicago Tribune, 28 November 1993.

call forth, while colours and smells create sounds for those with this condition. Although these experiences are intriguing in their quirkiness, their physiological cause has yet to be fully explained.[4] Nevertheless, they are proof, to some small extent, that perceptual associations, which are not normally expected, can, and do, occur. Furthermore, since these perceptual experiences cause actual emotional discomfort to people with synesthesia when the "colours are wrong" (for shapes and movement in illustrations or paintings), one must accept the basic existence of such emotional/colour/word matches.

Since it is known that these emotional associations with words and colours exist, the next step to be determined is whether it is possible to formulate some system which will explain and predict these universal associations. The emotional and psychological associations which become attached to words, and especially to words describing colours, proved endlessly fascinating to Seurat and any system to anticipate the associations would have been a godsend to him. There was a widely accepted notion in Paris of the late 1800s that there must be in existence a "..universally applicable grammar of sensory experience" and the only block to applying this grammar was finding the key to set it into motion.[5]

Charles Henry (1859-1926) provided such a key and his Esthétique scientifique (1885), which incorporated the basic tenets of Symbolism, was his first effort to express the sense of relatedness which he believed to exist across the arts. During his lifetime efforts to prove this universal interrelatedness, he

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[4] It is thought that this condition occurs in the limbic system where the senses interconnect rather than at a higher level of processing in the brain.

[5] John Russell, Seurat, London, 1965, p. 192.

"...sought to embrace all of art--painting, poetry, literature, music, philosophy--under the wing of science."[6] He believed that the mathematical laws could provide the protective cover under which all representations and relationships between objects could be deduced; "he wanted to reformulate the doctrine of harmonic unity as psychophysics and the doctrine of harmonic works as psychophysical aesthetic".[7] If Henry could define the inter-relatedness of the arts through an understanding of these mathematical laws, then this, he believed, would lead to a greater fulfillment and enhancement of life.[8]

Of particular interest to Seurat was the fact that Henry wanted to stimulate the artist's interest in the expressive possibilities of colour and line, this he did through his psychophysical aesthestics. The emotional connotations of colour fascinated Henry: achromatic hues of black and white were seen as cold and factual with no nuances allowed while chromatic hues were emotional and could cross language barriers as they wrested reactions from the viewer or induced the viewer to be calm and contemplative. Henry's aesthetic theories on colour served to enhance and integrate the theories of the day. As Rookmaaker states: "This is one of the very rare cases in the 19th century that aesthetics in the proper sense directly influenced the artists..." [9]

Henry's next major effort, Cercle Chromatique, which was begun in 1886 but not published until 1888-1889, opens with the

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[6] Faber Birren, History of Colour in Painting, New York, 1965, p. 229.
[7] Argüelles, Charles Henry and the formation of a psychological aesthetic, Chicago, 1972, p. 10.
[8] Russell, Op.cit., p. 192.
[9] Rookmaaker, Synthesist Art Theories, Amsterdam p. 92. Henry was a precocious researcher who, by the age of 27 had written or edited 19 books.

statement that the special focus of its pages is the sensation of colour.[10] With this work, Henry

> ...thoroughly integrated line, colour and value. He constructed a graduated wheel on which the locations of the colours and angles of incidence, or distances between them, corresponded to dynamogenies and inhibition, and he applied numerical schemata to guarantee combinations which would be effective.[11]

Dynamogenous, or pleasurable, continuous functions were defined by Henry as those whose directions go from low to high vertically and left to right horizontally. Inhibitory, or disagreeable, discontinuous functions were defined as those whose directions go from high to low vertically and right to left horizontally.[12] Henry considered these to be universally applicable concepts and he established states of dynamogeny or inhibition for spatial directions, colours and rhythm and measure in forms.[13]

Henry speaks of "arrêt", which has been taken to mean an arrest or stop. Each arrest within a cycle is distinct from another because it involves a change of direction and, thus, a contrast. Contrasts may be simultaneous or successive and the direction of the contrast will evoke a colour's complementary with each change.[14] Thus, spectral colours are dynamogenous, and, when mixed, combine to form white as they move from left to right. Pigment colours, on the other hand, are inhibitory, and, when mixed, combine to form black as they move from right to

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[10] Unless otherwise cited, the discussions of Henry's Cercle Chromatique, Paris, 1889 and his Rapporteur Esthétique, Paris, 1888 are from my own readings which were done from very poor quality microfiche reproductions of the original texts. Any direct quotes are from other scholars' readings of Henry since words were missing in places from my microfiche copy.

[11] Herbert, in Sutter, The Neo-Impressionists, London, 1970, p. 35.

[12] Henry, Cercle Chromatique, p. 3.

[13] Birren, History of Colour in Painting, 1965, p. 229.

[14] Henry, Cercle Chromatique, p.11.

left. Although the resulting colours from the spectral or pigment mixtures echoes the theories of Chevreul, Rood, Young et al., the notion of the psychological reaction from these mixtures was a bonus Seurat received for consulting Henry's writings.

Henry next identified three primary colours: Red, which sustains the most intense arrests and moves from low to high; yellow, which has less arrests and moves from left to right; and, blue, which moves from right to left with even less arrests.[15] These colours go in three primary directions with each direction evoking a complementary direction and, thus, a complementary colour. If this sounds familiar, it is a restatement of Chevreul's idea of simultaneous contrast.

Henry spells out at length the basic theories behind his synthesizing aesthetic and says that visual sensations are the result of 3 simultaneous aspects: Luminosity (light), chroma (colour), and schema (form).[16] Colours will evoke their complementaries but, when a colour change occurs, a new aspect appears; thus, the sensation of colour is the realization of a change of direction. Therefore, Henry's concept of direction is a psychological one involving an optical shift as well as a psychic one; this theory of direction and its relation to psychic states is one of Henry's main ideas.

Rhythm, which is the identification of the changes of direction and measure--in a given direction this is the number of dynamogenous points of arrest--rounds out Henry's ideas in Cercle Chromatique.[17] Measure is only different from rhythm in the special nature of the representation; rhythm is more subjective

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15 Henry, Cercle chromatique., p. 21 and 22.
16 Henry, Cercle chromatique, p. 16 and 35.
17 Henry, Cercle chromatique, Section III, pp. 14-18.

while measure falls into a mathematical realm and is thus more objective.[18] Therefore, rhythmical coordination of cycles should bring on a desired dynamogenous state. This is done by adjusting the forms so that the form is a harmony of directions productive of a rhythmic number and is thus visually perceived as a function of a rhythmic cycle; this is the harmony of forms.[19]

A perceptive artist will develop a feel for forms and lines and will soon be able to tell which will be most agreeable within a composition. Henry proposed that if lines are an abstraction as the synthesis of the perceptions of an object, then direction would be the reality which the lines supposed.[20] Subsequently, some lines and direction would be more agreeable and pleasurable than others. If pleasure is determined not by the intensity of a sensation, but by the continuity of a sensation, then the artist must become aware of what a direction change or colour change will mean.[21]

Henry's chromatic circle allowed an artist to choose specific angles and colours in order to elicit specific emotions while his next major publication, Rapporteur Esthetique (1888), involved the scientific measuring, via a protractor device, of the harmonious beauty of line and form. To determine whether an outline was harmonious or not, it was broken down into polygonal segments and then measured against the Rapporteur; compilations of the results were listed in a table by Henry and indicated, at a glance, whether harmony had been achieved.[22] What was important for Henry was that, since directions were capable of being given

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18 Henry, Cercle Chromatique, introduction.
19 Argüelles, Op.cit., p. 47.
20 Argüelles, Op.cit., p. 27.
21 Henry, Cercle Chromatique, conclusion, p. 53.
22 Henry, Rapporteur esthétique, p. 451.

numerical equivalents with Rapporteur Esthetique, it was possible to obtain a mathematical expression for psychic functions.[23] Thus, Henry's chromatic circle, in conjunction with his Rapporteur Esthetique, provided the artist with the knowledge regarding the measurement of and effects from colour, form, direction and rhythm; and all of this, probably to Seurat's delight, was provided with a fair degree of scientific certainty.[24]

The two features of Henry's theories that should be emphasized because of their relevance to Seurat and to the whole development of modern art are "...movement, the dynamic component, and line as abstraction, the schematic component."[25] We react to the artist's movement by reading the lines; if there is no movement, there is no reaction and we exist as before. Since a line is an abstraction and is the synthesis of two directions, there are two ways it can be drawn; therefore, "...line is the cipher of a given, devoid of the subject matter it depicts..."[26]

Henry felt that effective or successful art must expand and build upon the agreeable within a person as well as without, and its effort must be felt internally and externally in a sort of physical action and psychic reaction.[27] This created a duality which required something to transcend the dominant system while using the tools of that selfsame system to accomplish the

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[23] Barbara Stafford, Symbol and Myth: Humbert de Superville's Essay on Absolute Signs in Art, London, 1979, p. 183.

[24] The Rapporteur was available commercially by 1889. See Note 48, in Dorra et Rewald, Seurat: L'ouevre peint, biographie, et catalogue, Les Beaux-Arts éditions d'études et de documents, 1959, CVI.

[25] Herbert, in Sutter, Op.cit., p. 35.

[26] Herbert, in Sutter, Op.cit., p. 35.

[27] Argüelles, Op.cit., no specific page. Argüelles had a tendency to treat Henry as a mystic and this slant must be recognized and treated cautiously.

transcendence. Henry's concepts of dynamogeny and inhibition, together with the notion of directions, provided the means of transcendence while working within the given system.

Prior to 1886, Seurat had tried to control his colour harmonies according to the laws of physics and optics but now he also tried to control "..the other elements of the picture--design, structures, line, and the distribution of movement and force--to laws equally stringent"; these laws were the laws as outlined by Henry.[28] Towards the end of that decade, Seurat's emphasis on his colour theory seemed to be supplanted by Henry's interests in the expressive qualities of colour and line.[29] It was Henry's aesthetics of colour and line which intrigued Seurat enough to incorporate their effects into his later paintings.

More than any other recent writer, Homer attempted to relate the ideas of Henry to those of Seurat and, especially, to Seurat's later works.[30] Broude feels that Seurat's goal was to "fix the fundamental principles and sources of color as divorced from all intuited whim and determine the esthetic and intellectual expression of lines" before she adds that Seurat realized Henry could not provide a literal formula for painting.[31] Then after citing problems that only a painter could solve intuitively--implying that only an artist could deal with certain "art" problems--Broude states that Seurat, "..nevertheless felt an absolute need to base his theories on scientific verities."[32] Seurat had a quandry to deal with; there was no literal formula

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[28] Russell, Op.cit., p. 197. Specific examples of Henry's influence upon Seurat's works will be cited in Chapter 5.
[29] Herbert, in Sutter, Op.cit., p. 24.
[30] William Homer, Seurat and the Science of Painting, Cambridge, 1964, pp. 188-249.
[31] Norma Broude, Ed., Seurat in perspective, USA, 1978, p. 29.
[32] Broude, Op.cit., p. 23.

for painting yet he craved scientific approbation for his procedures. The extent to which he based his approach on influences outside the world of art such as Helmholtz's science or Henry's aesthetics can only be determined by searching for these specific qualities in his works and, even then, we may be reading too much into what remains on the canvas.

Symbolism and other influences

There has been a trend with some recent research to play down Seurat's scientific affiliations in favour of looking at stronger links with the Symbolist movement. Symbolism evolved as a reaction against the past emphasis on detail and absolute descriptive fact in art while simultaneously "turning away completely from the rapidly advancing industrialization of the contemporary world."[1] Basically, Symbolists stressed an emotionally expressive and imaginative approach which might seem in opposition to what Seurat was attempting with his methodical approach. Yet this does not suggest that Symbolists espoused a pure, free expression of feelings. If they had had a motto, it would have been: Think, reflect, don't improvise.[2] This Symbolist emphasis on the inner, emotional world of the creator was very much in direct opposition to the 19th century stress on modern technology and the external world.[3]

Seurat's later works of 1886-1888 grew to parallel this movement as they became more systematic in presentation yet more emotionally expressive in nature. Seurat's Chahut of 1889-1890 may be seen by some as the time when the Symbolists formally adopted Seurat.[4] For example, the curved upper borders in this painting were examples of both Superville's and Henry's notions regarding the expressive nature of lines.[5] Both the Symbolists and Henry, in particular, had concerns with harmony in the arts.

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1 Phillipe Jullian, The Symbolists, London, Phaidon Press, 1973, p. 9.
2 Richard Thomson, Seurat, Oxford, 1985, p. 132.
3 Anthea Callen, Techniques of the Impressionists, London, 1982, p. 134.
4 See Illustration 54.
5 The reason for the curved, painted border in Chahut is supported by Seurat's own notes. The reader may examine the discussion on Seurat's Esthétique in Herbert's Georges Seurat: 1859-1891, Appendix E, p. 381-383.

During the 19th century, there seemed to exist a strong inclination towards identifying the associations between harmony in music and harmony in colours, or harmony in colours and harmony in the written and spoken words.[6] Critics wondered if it were possible, in reality, to make such analogies. Harmony in music involves the dissolution of separate tones as a chord is created, harmony in art comes from pleasing blends of separate colour components, and harmony in words comes from rhythm, inflection of tone and choice of basic components, i.e., the words. If one hears a harmonic unity in music, and this harmony is actually felt; what then, happens with colours?[7] Furthermore, how would a harmonic unity with colours be felt and would certain harmonies be universal enough to evoke specific emotions?

The aesthetic associated with Richard Wagner offered the ideal analogy between music and colour and some scholars believe that there is a strong connection between "Wagnérisme" and Seurat. For example, comparing Seurat's dark frames with their foreboding feel to the nature of Wagner's work has been examined in some detail.[8] From 1886 onwards, Seurat was in close contact with the Wagnerites in Paris whose approach was that a work of art should "transform its ordinary materials, transcend its usual state and emphasize the artifice of the [process of] making the work itself".[9] Seurat's later paintings used many devices to achieve this: stylized figures; artificial presentation; and, a

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[6] See previous section in this chapter on Charles Henry.

[7] One wonders how a synesthete would define a harmony of colours...see the previous discussion on aesthetic influences in this chapter.

[8] See Paul Smith's Ph.D. "Seurat, the language of idealism, and the concrete conditions of avant-garde practice", University of London, 1990. Part of this has since appeared as "Seurat, the natural scientist?", Apollo, December 1990, 383-385.

[9] John House, "Seurat and the politics of the Avant-Garde", Seminar at The Metropolitan Museum of Art, 4 October 1991.

calculated viewing distance, partly through presentation and partly through the frames. This forced separation of the viewer from the artwork was in total agreement with Wagner's approach, which allowed for enjoyment but kept enough sense of detachment intact so that the process of creation was always recalled.[10] Thus, the spectator, or listener, was forced to become an active participant in so far as the artwork, or music, must have its presentation deciphered in order to gain its meaning.

Although Seurat employed the above techniques, which really were much more symbolist than impressionist in approach, there was still no guarantee that a colour harmony ultimately would be achieved. It has been suggested that one way to handle this problem is by assuming colour harmony works along the lines of Gestalt thought; the whole is greater than the sum of its parts.[11] An easier way to perceive colour harmony would be when colours are presented in whole units: textiles and decorative arts employ this method beautifully; we perceive a lovely tapestry and look at the "overall" colour tone, not the individual bits.[12] This may be why it is easier to pick up on colour harmonies in non-representational art; we look at the whole rather than being distracted by the parts.

If this is the case, then the broken-down, unblended colour presentation offered by Seurat should lend itself to easier colour harmonies. The Symbolist writer, Félix Fénéon, supported the Neo-Impressionist movement. Though, "Chromo-luminarist", a term Fénéon is thought to have supplied, is, perhaps, a more appropriate term since both the Impressionists and Neo-

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10 House, Op.cit., seminar, 1991.
11 Peter L. Jones, Form and Meaning in Colour, Seminar, 1985, p. 3.
12 Jones, Op.cit., p. 7.

Impressionists sought to work with colour and light but the first was by "spontaneous renderings while the latter was by a deliberate process."[13] Thus, the deliberate process of Seurat's analyzing the available light's colour and presenting it its integral parts--with the intention of these parts re-grouping upon viewing--should pave the way towards a harmonic whole, in Gestaltian terms, if nothing else. And this, quite neatly, harkens back to the Wagnerian chant of transcendence of the component parts towards a greater goal.

Yet, it must be noted that the goal of achieving harmony, whether in music or colour, is not the be-all and end-all. Harmony, and the pleasure derived from it, is a process; it is during the process that we receive pleasure; having complete harmony is a resting stage because we have attained the goal and staying there will soon become boring. Since the "optimum state for the organism is not rest but a moderate level of arousal"; great colour harmony, then, should provoke, tease and stimulate.[14] Even if the general concensus failed to agree on the outcome of Seurat's works, few could argue that his efforts were not thought-provoking, if not utterly provocative.

In addition to all of the changes and confusion which faced the 19th-century artists, there were two other developments which affected the way artists "see" and which need to be mentioned, however briefly. Photography and the increasing availability of Japanese prints presented a vision which, if they did not directly affect a particular artist, could not have helped but

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13 John Rewald, Seurat: A biography, London, 1990, p. 114.

14 Jones, Op.cit., p. 9 in reference to some expression of Wundt's about maintaining a state of some activity and arousal for the most pleasure (direct source not provided).

influence the artistic milieu with the different perceptions they offered.

Since the development of photography in the 1840s, an artist was presented with reproductions of a scene which were stark and revealing; gone were the possiblities for chiaroscuro and soft, indefinite contours as the strong tonal contrasts and dramatic shadows were presented on the photographs.[15] The artist was now presented with a "real" view of a scene; the camera seemed to see objectively and allowed for no subjective interpretations during the infancy of photography. What appeared in a photographic frame had harsh shadows, an unchangable perspective and was in grainy tones of black and white. Furthermore, the camera could focus on only one depth of field while the human eye could adapt effortlessly from near to far. Thus, something in the foreground could be photographed in sharp focus while the immediate background would show up blurry and indistinct. Artists now had to decide how to handle the new insight offered by photography and whether they would adjust their techniques accordingly.

The increasing popularity of Japanese prints in France during the 1860s offered artists another new way of "seeing". The decorative prints produced some very naturalistic aspects even though they employed flat blocks of colour and an Eastern view of perspective which marched objects of decreasing size one behind the other. The result was a "spatial and compositional flatness" as the eye was allowed to roam all over the canvas rather than focussing on the one central focal point.[16] Artists

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15 Callen, Op.cit., p. 27.
16 Callen, Op.cit., p. 31.

were intrigued because such effects could be elicited from compositions which relied upon geometric shapes and their placement rather than their dimensions and contours, and flat blocks of colour rather than tonal modelling. The effectiveness of these prints showed that the "approved" techniques in the nineteenth century were not the only ones which worked. Again, artists could now choose whether or not to experiment with the new style.

This chapter has shown some of the great strides that researchers were making in the 19th century concerning the visual process and colour vision in particular. Obviously, Seurat could not have known of all of this research but we know that he was acquainted with a fair amount of the work going on then. However, no one can be appraised of everything and some key research at the time seemed to slip past unnoticed even though it would have proven consequential for Seurat. For example, in 1873 von Bezold stated that the entire spectrum appears colourless if the intensity of the illumination is sufficiently low and both Hering and Hillebrand confirmed these findings later on in 1889.[17] Although Seurat would have been too young in 1873 to comprehend von Bezold's findings, the replications of and eventual support for von Bezold's work occurred throughout Seurat's lifetime.

Another pertinent find was published just 3 years after Seurat's death and explained how colour matching with small fields subtending 20 minutes of arc of less shows that the foveal centre is, in fact, dichromatic.[18] The findings of this research

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[17] James P. C. Southall, Introduction to Physiological Optics, New York, 1937, p. 274.

[18] A. König, S.B. Akad. Wiss. Berl., 21 June 1894, p. 577. The explanations of dichromatic foveal colour viewing are examined in detail in Chapter 6 both for the effect it would have upon a pointillist colour presentation and upon colour viewing in general.

were not complicated but the implications it held for anyone wishing to achieve a visual blending of individual spots of colour were phenomenal. Unfortunately, we can only speculate upon the effects this publication would have had upon Seurat's approach to his work due to his untimely death.

Research towards the end of the nineteenth century furthered scientists' understanding of the human visual processes. Much of the original findings of Helmholtz and Hering were supported and expanded upon while a general fine-tuning of the knowledge of vision continued. Thus, in 1894, The Duplicity Theory was named and supported by the firm scientific work of v. Kries (1853-1928). This theory stated that two distinct systems or functions are involved in vision: 1) the cones which work better when the eyes are light-adapted, and 2) the rods which work better when the eyes are dark-adapted, both worked to produce visual effects.[19] Vision with light-adapted eyes is called, photopic; vision with dark-adapted eyes is called scotopic. v. Kries' research also showed that the eye's maximum sensitivity is towards the blue end of the spectrum in twilight vision; this affirmed Purkinje's findings of 1825 where blues and greens will appear brightest for a dark-adapted eye while reds and oranges appear darker to the same eye.[20] Findings such as these continued

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[19] Southall, Op.cit., p. 274. See also W. Wright, The measurement of colour, (4th ed.) London, 1969, p. 345 where these findings are expanded. The implication from the Duplicity Theory is that "there is not simply a morphological duality of the elements of the retinal neuroepithelium, but a corresponding duality of function as well, and that to a certain extent there are two kinds of vision." See also W. Wright, The measurement of colour, (4th ed.) London, 1969, p. 345 where this discussion may be consulted.

[20] Southall, op.cit., p. 274. This effect was especially noticeable when the light was too feeble to disturb the dark-adapted eye but was just strong enough to trigger the daylight mechanism. During twilight this is most noticeable and the effect created by the transition between the two systems has been named the Purkinje shift.

to define the world of the artist and will be discussed at length in Chapter Six. However, since the world of Seurat ended in 1891, we shall confine our examination of his later works to the knowledge to which he would have had access and leave our speculation about the veracity of his approach until later.

CHAPTER FIVE

Towards Seurat's Later Works

We have already mentioned some aspects of Seurat's drawing technique and how his palette was adapted as his painting style evolved from his approach to drawing, the mechanical manufacture of paints and how far Seurat could manipulate them to serve his purposes, and we have looked at his first two major canvasses in detail. Seurat's techniques seemed to change almost with every canvas he painted. Certainly there are great differences between his major pieces as his work underwent constant experimentation. His concern with colour theoriés, his unstated requirement that the viewer play the game and move about and back and forth to reap the benefits of his technique, his desire to make full use of the expressive nature of colours and lines; and, perhaps most of all, his questioning mind drove him onwards to try new combinations as he refined his approach to his work. It was the aesthetics of colour as studied by Henry which intrigued Seurat; Seurat's incorporation of the expressive qualities of colour and line after 1886 almost came to supplant his original strong interest in colour theory.[1]

In this chapter I will examine each of Seurat's later major pieces in terms of their visual effects and what seems to be the main impact, if there is only one, of the piece. I will also look at a few intermediate paintings, i.e., paintings which were painted in-between these more recognized larger works. In regards to his dozens of marine studies and landscapes, I am afraid I cannot do them equal justice. Some discussion will

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[1] Herbert, "Seurat's Theories" in Sutter's, Neo-Impressionists, London, 1970, p. 24.

ensue on one or two of the paintings falling into those categories but, since I was unable to study these in-depth and was only able to see them for the first time at the Paris and New York exhibitions, my comments will, of necessity, be kept brief.

I have chosen three of Seurat's paintings to discuss first, in a fair amount of detail, because each one has stood out in my memory for one or more reasons: Bridge at Courbevoie shows definite areas where Seurat changed and reworked his composition; Le tour Eiffel shows mastery of divisionism and employs a complicated coloured border; and, Beach at Gravelines employs aspects of the first two showing an added border and perhaps reworked edge with a simple yet effective use of dots. These three paintings were painted over four years of Seurat's life and were punctuated by works produced during summer visits to the seaside and major works done throughout the year in Paris.

Seurat spent the summer of 1885 at Grandcamp, a tiny fishing port in western Normandy, and this holiday marked the beginning of yearly breaks for Seurat as he eventually visited Gravelines, Honfleur, Port-en-Bessin and Dieppe; in all, Seurat spent five summers at Gravelines and completed some two dozen full-scale landscapes there alone.[2] It is possible to see a very definite influence from Monet in Seurat's asymmetrical placement of a single monumental item, although Seurat always included--in his later works--man-made items, whereas Monet did not.[3] There was always some indication of commerce and progress in Seurat's later seascapes which combined nature with man's influences. It was at Grandcamp in the summer of 1885, that Seurat developed his dot

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[2] Ellen Lee, "Beyond the Point: Seurat and the Summer Landscapes", Seminar at the Metropolitan Museum of Art, New York, 25 October 1991.
[3] House, "Seurat and the Politics of the Avante-Garde", Seminar at the Metropolitan Museum of Art, New York, 4 October 1991.

technique and the canvas Le Bec du Hoc, Grandcamp employs this on the subject of the one large rock precipice; yet, despite "a reduced size of touch, the shape of the mark still varies, subtly differentiating textures and following forms."[4]

Seurat's summers on the coast provided him with opportunities to study natural light on a variety of subjects; his subjects were not always "picture-worthy" yet he created a wonderful play of light and colour and complexity out of these rather mundane views. Gravelines, for example, was a tiny town situated where the English Channel met with the North Sea; it was not an extremely popular or scenic place and, basically, was a rather spartan situation with a strict natural geometry between the town and its two hamlets. Although Gravelines was a busy port, Seurat focussed on the lesser seen and populated areas; his extremely geometric compositions of un-peopled scenes were softened only by lighter, pastel colour usage.[5] His tendency to seek out geometric situations with little human interest, i.e., very few non-descript figures of indeterminate purpose were included, while he continued his research on colour and line, was envinced in the canvas Bridge at Courbevoie.

Seurat's Bridge at Courbevoie (painted signature "Seurat" in lower left hand corner in red and blue dots) was painted in 1886 and shows the working changes as Seurat dealt with his composition.[6] The overall colours of this work are mossy greens, twilight blues, faded Easter-egg lilacs and pinks; the warmer colours are meant to "pick-up" the sunlit areas and the cooler

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[4] Anthea Callen, Techniques of the Impressionists, London, 1982, p. 112. See Illustration 4.
[5] Ellen Lee, Op.cit., seminar 25 October 1991.
[6] See Illustration 55.

areas help to tone down the shadows; also, the opposing colours are nearer those suggested by Rood than Chevreul. The only vivid colour is the undercoat for the tree branches which enter the picture on the left; they are an emerald green and done in balayé style.

All vertical posts and masts, the tree and figures seem to have been laid in with a light wash of a dark blue.[7] The ground colour of the tree is dark blue. The faint traces of the tree trunk on the right remain under a cover of dots as an indication of a compositional change; although the dots in this painting "go outside the line" and march back in forth over the contour, one still is able to discern the changes.[8] The tree trunk has red, green, orange, blue and lilac coloured dots over the surface

which are spaced and sized approximately like this:

The off-white ground colour of the sky is comprised of balayé strokes, mostly up and down diagonals; the direction becomes apparent from the broader beginning point, where the brush was first laid down, to the tapering finished end of the stroke, where the brush was pulled away from the canvas with some

flourish. The first layer of strokes look like: Small light blue, pale green, lilac and gold strokes--not really dots--cover the sky and echo the colours used on the rest of the

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[7] Impressionist & Post-Impressionist Masterpieces: The Courtauld Collection, London, 1987, entry 34; hereafter called The Courtauld Collection. The catalogue states that underneath the spots on the main tree on the right it is possible to see the Prussian blue and crimson lake drawing with which the composition was initially laid out.

[8] See Illustration 56a.

canvas. Some directional strokes exist in the reflections on the water but not as much as the reproductions seem to indicate; and, again the colours in the water are similar in content, and intent, to those in the sky.[9]

There is no indication of a border, or plans to lay one in later. The dots curve just around the edge of the canvas. The dots are a fairly uniform size and range from  to  .

There appear to be some areas that are reworked because the paint is applied thickly yet, in other areas, some undercoats of paint manage to glimmer through the top layers. A thickly layered, wedge-shaped area, to the left of the first free-standing mast and from the large tree on the right, seems to be reworked. Both of the golden-hued boats on the water, the one in the centre of the work and the other on the left side, are heavily worked. The two large boats appear to have been reworked on their side sail supports, they each seem to have been moved down and to the left.

The Courtauld catalogue makes a good observation concerning the masts of the boats and the chimney stacks. The verticals in this painting are all tipped slightly to the left and although this makes all the verticals within the canvas parallel, the vertical bounds of the canvas edges and frames are unrelated.[10] I don't know that I agree with their notion that this was intended as a visual separation, for one reads them as vertical and doesn't consciously question whether they are at 90 degrees or 87. However, the catalogue quite rightly notes that considering the degree of forethought and precision with which Seurat

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[9] See Illustration 56b.

[10] The Courtauld Collection, Op.cit., entry number 34.

approached each canvas, this tilt must have been intentional. I would like to offer a possible explanation based on graphology: tilting toward the left is an indication of a desire for the past or a greater affinity for what was known. Perhaps Seurat has put in this tilt to help evoke feelings of nostalgia bordering on melancholy for things lost. If so, perhaps we have discovered the first case of subliminal advertising!

Viewing this painting from a distance of 10-12 feet provided me with the impression of a cold, misty day at the riverfront. The characters are static; it could be a Sunday afternoon in St. Andrews in February, the feeling is so melancholic. The colours become muted at this distance. The main tree trunk becomes flat and not much texture is apparent on the trunk. All of the modulated tones from the dots blend into a neutral nothingness; the tree trunk seems to be in shadow yet it should show a lit area since it is in the direction of the sun's light. The grass retains some sunlit areas which give depth to the rest. The water now looks like frozen milk; there is no sensation of its being a flowing river. The sky remains hazy and overcast.

It is strange to note that the tree on the left is heavily laden with lush foliage while the tree on the right is starkly bare. One might think that the tree on the right is dead but careful observation shows that foliage had originally been put in--just to the left of the branches--and then painted out. There is a contrast between the stark, bleak wintery feel of the this tree and the tree bursting with life and vitality on the left.

In surprising contrast to my reaction to the time of year and the feeling from the painting, Herbert begins his discussion

of this canvas with the words, "On a still, humid afternoon, a silvery sunlight washes over the embankment of the island of La Grande Jatte..." and continues his discussion of the canvas describing the strange disparity in the representation between the two trees as, "a frothy mass of foliage floats down from an unseen tree, while on the far side, as if in compensation, rises a tree that lacks foliage...adds a brooding touch.."[11] Herbert is reading humidity and torpor from an image which, to me, suggests bleaker wintery conditions. Indeed, if one were consult the colour reproduction included in the Seurat exhibition catalogue, the image is green and fairly lush; and, indeed, perhaps Herbert was consulting a colour reproduction when he made his comments.[12] However, when I viewed the painting at the Courtauld, the last sensation on my list would be that of humidity.

Herbert was able to ascertain that this painting was exhibited in March of 1887, after Seurat had completed it some months earlier; this would place the execution of this piece during the last several months of 1886.[13] For Seurat, the year 1886 saw the completion of La Grande Jatte in the springtime, a summer spent at Honfleur and production of the Honfleur images upon returning from Honfleur; and, somewhere towards the end of this productive year, he also painted The Bridge at Courbevoie. Herbert further supports his interpretation of the painting in the section describing a small drawing made of the same site; apparently the drawing was done on site while the canvas was

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11 Herbert, Georges Seurat: 1859-1891, 1991, p. 256.

12 The colour reproduction of Le pont de Courbevoie, which Herbert indicates, is located on page 257 in Georges Seurat: 1859-1891.

13 Herbert, Georges Seurat: 1859-1891, p. 258 with documentation included in Appendix A of the same book.

toted back and forth on subsequent visits.[14] Although Herbert's greater investigative skills have enabled him to narrow down the time Seurat would have had to paint this painting, I still cannot agree with his interpretation.

To me, the painting remains basically cold. There is a chill in the air which indicates winter's approach; two of the three figures are heavily clothed; shadows are weak and the sun is not strong enough nor high enough to dispel clouds in the overcast sky. As I stated before, there is a feeling of melancholy about the place; even Herbert used the word "brooding". Perhaps the lack of foliage on one tree represents the changing seasons at the end of summer. This ties in more with the backwards slant of the vertical lines if Seurat wishes to hold on to the immediate past since it, too, indicates a preference for the immediate past. Lastly, reading from left to right, our natural inclination, one follows movement from greener vitality to greyer suspended animation; a transitional time.

This painting is a good indication of the struggles Seurat was still having trying to break free from his classical academic training. The mixture of brushstroke styles, the movements of the figures on the canvas, the use of the spots for graphic description, and his very deliberate visual discrepancies which preclude the viewer from easily placing the time of the scene, show he is still in some conflict as his theory develops. Although, with the physical evidence of his indecision, there is just the tiniest sense that Seurat is more in control than he has

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[14] Herbert, Georges Seurat: 1859-1891, p. 258. There is no corroboration given for this explanation of Seurat's methods nor is there any documentation provided which indicates the source of Herbert's explanation.

lead us to believe and that the revelation will only come about when he deigns it.

From the time that Seurat painted Bridge at Courbevoie in 1886 to the next canvas under discussion, Le tour Eiffel in 1889, Seurat had enjoyed summer breaks in Honfleur (1886) and Port-en-Bessin (1888). The works done during these visits saw Seurat's technique becoming more consistent and controlled regarding his colour application while his compositions were better planned combining a "design and lyricism" which had not been so apparent earlier.[15] The continuing refinement of Seurat's technique helped the viewer to become less concerned with the dots themselves, sometimes to the point of being stopped by the method, to become more involved in the effect from the technique; a subtle yet very important shift of focus. A good example of this effect is found in Le tour Eiffel.

From photographs taken during the construction of the Eiffel Tower, it is possible to discern that Seurat painted Le tour Eiffel in January of 1889.[16] This piece is a very detailed pointillist painting of the Eiffel tower with the only vague area being the top of the tower which was not yet completed when Seurat painted the canvas. Pleasingly, one sees the scene before one realizes that it is comprised of dots.

This croqueton has a painted border on all four sides and Herbert feels that this may be the first piece that Seurat did which involved the border from the moment of conception; any paintings with borders done before this time had been reworked months or years later when Seurat began to frame in his pieces

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15 Lee, Op.cit., seminar 25 October 1991.

16 See Illustration 57a taken from the cover of the New York symposium mailer. The actual painting is not much larger than this cover.

with painted borders.[17] Interestingly, Fénéon told César de Hauke that part of the original frame around Poseuses had been cut down and used on Le Tour Eiffel amongst other paintings of Seurat's.[18] Sadly, I only witnessed a painted border; having a painted border and a painted frame would have been better to assess the colours' arrangements. Even so, the colours in the border are complicated and carefully contrast the colours which are next to it in the composition; this is surprising to find such attention to detail since the entire painting is quite small.

The colours are light and the dappling of the oranges and yellows throughout the scene, including the sky, makes one feel that the day is sunny and the air warm. There is still some graphic description with the dots outlining the girders of the tower but, with some of the girders being only one dot wide, it would be difficult not to fall into this linear format. Though the dots are more nearly uniform in size on the final layer, one still can see the underlying balayé and note the ridges in the paint where Seurat enthusiastically dabbed the brush on the canvas.

Herbert states that Seurat was one of very few artists who painted the tower when the rest of the world was condemming the structure; in it, he says, Seurat found "...a structure composed, like his painting, of clearly visible units that reveal its technique."[19] This may suggest that Seurat saw his technique as being aligned in terms of the "new" world of science and technology. His basic training of finding the geometric

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[17] Herbert, Georges Seurat: 1859-1891, p. 328. The sole exception in the panel for Poseuses which has a border on two sides and was painted in late 1886.

[18] Herbert, Georges Seurat: 1859-1891, p. 377 in Note 5, Appendix A.

[19] Herbert, Georges Seurat: 1859-1891, p. 328.

structures which underlie every figure, had come around full circle, and quite successfully, in this canvas.

The summer of 1889 was spent at Dieppe where Seurat painted only two seascapes since, by then, Le Chahut was well under way.[20] Seurat's novel experiments of this summer involved detailed painting of the painting's frames; Seurat wanted a frame to insulate and enhance his colour scheme.[21] The frames painted during this summer of 1889 were in ultramarine blue which lent an extra luminosity into the scene of the painting. Yet, Beach at Gravelines, painted just one year later, has a painted frame but one which "pulls" the viewer out of the scene, rather than focussing the viewer's attention in towards the painting.

Beach at Gravelines was painted during the summer of 1890, the last of Seurat's life, in his fifth visit to Gravelines.[22] Though this was not one of the four full-scale seascapes he painted that summer, this piece shows more emotion and vitality than the four bigger paintings seem to have been allowed.

There is a border on all four sides. A stripey "caught-edge" quality on the inner edges gives the feeling that Seurat painted around a template; this is especially apparent inside the left hand side border where a solid line runs parallel to the painted border, stops, and starts again. This left-hand side caught-edge line runs over the painted interior scene of the two bottom sand bars, so the border must have been added after the scene was painted. The borders are comprised of directional, stitch-like strokes; there is no attempt to round-off or modulate the shape of the colours.

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20 See Illustration 54.
21 Lee, Op.cit..
22 See Illustration 57b.

The borders are primarily painted in blue. There are 12 red dots on the left hand side, no red on the top, 17 red dots on the right hand side and 5 orange dots, and solid blue on the bottom; none of these dots reflect any colours or shapes in the interior of the painting. Since the painting is wider than it is high, it seems strange that the majority of warmer-coloured dots is packed into the left- and right-hand shorter sides. Although, if one considers standing on a beach, the usual impression is of blue sky above, blue waters below in front and wet sand running up to the observation point; thus, putting red on the sides is more logical than putting it into the blue-areas of sky and water; plus, red on the edges gives some sense of warmth.

This scene divides into two halves each with two distinct colour combinations: the sky and the beach. There are larger, horizontal strokes used in the sky and the creamy white ground has been spotted over with light blue, lilac, and goldenrod-coloured spots. The beach is comprised of dark blue, some spring green, light and dark orange (red?) spots which seem larger than those used in the sky, but this effect is primarily due to the brighter colours which have a tendency to stand out more. The main colour contrasts are blues against oranges and yellows. Portions of the white priming show through which adds to the luminous feel of this strange overcast day; there is light in the air but it is a day without shadows.

The centre boat figure is made entirely from six simple blue strokes topped with orange and is shaped thus:  . The boat is placed just off centre to the right which helps to offset the heavier visual weight of the wider strips of beach on the left.

On the left hand side of the work are the two scraped lines which cut into the paint layers. The first runs vertically from the top to the first sandbar, 1/4" in from the blue border and the second runs from the top to the horizon's sandbar 5/8" in from the border. Was Seurat testing for the placement of the left hand side border? This is not explained in the Courtauld catalogue but a mention that sand has been found imbedded in the pigments on this canvas suggests that he was working outdoors and perhaps an over-zealous application of the edge of his knife or some straight-edged tool may have marked the canvas.[23]

Viewing this little painting from a distance of up to 10-12 feet evokes slightly different impressions. The beach now looks like a pebble beach. Some sense of depth and perspective still exists, but it is slight. The sandy pebbled area is very distinct when compared to the hazy horizon and the boat. The water, as in Bridge at Courbevoie, looks milky and has no sense of movement or depth. The milky sky is relieved by some clouds which are reflected, in part, in the water. These reflections, strangely enough, were not immediately apparent from a closer viewpoint. Seurat, once again, has provided a bonus for the viewer who is willing to work.[24]

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[23] The Courtauld Collection, Op.cit., entry number 37.

[24] A final comment on this grouping of Seurat's work concerns the paintings at the Courtauld; namely, Bridge at Courbevoie and Beach at Gravelines. It was in 1989, before the Courtauld moved to their new premises, that most of these observations were made. The lighting in the gallery was overhead from yellow-orange bulbs and, though sky-lights were in the ceiling, they appeared to be partially covered with rain-sodden cardboard. The colours of the walls were a deep apricot. All of the Seurats were framed in dark, heavy, dirty, ornate wooden frames whose incredibly elaborate edges flared out towards the viewer while they squeezed in the pictorial space unbearably, just about killing the effect of Seurat's paintings.

Frames and Borders

After having considered Seurat's technique and approach to his paintings, question of presentation needs to be assessed. The variety of borders and framing which Seurat used needs to be assessed not only for each individual frame's effect upon its painting but also for their collective role within his theory, if they play one. There has not been much investigation into this issue beyond mentioning a use of thin gold slip inside a frame, to separate the frame from the painting, to that of briefly describing the painted borders and frames themselves.[1]

During the course of my research on Seurat's paintings and drawings, I regularly ran across comments such as "border probably added by Seurat" in descriptions of certain works. My first reaction was, who else would have painted on a border other than the original artist? The replacing of frames can happen and is normal procedure when paintings change ownerships; but, who, other than the artist, would dare to change part of the actual painting? It would be like an apprentice putting a bright pink bow in Mona Lisa's hair to lighten up the scene and maybe make her smile a bit more. Ridiculous! The answers to some of my concerns finally appeared in Appendix A of the catalogue for the Paris and New York exhibitions in 1990-1991.[2]

Apparently, after the initial break from gold frames, Seurat finished his paintings in white frames before he began to paint the frames in varigated hues; lastly, he added borders to the

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[1] Since this section was written, I discovered that Didier Semin had a publication which discussed, in part, Seurat's frames. This was mentioned in Appendix A in Herbert's Seurat, p. 377. I did not obtain a copy of Semin's work and refer to reader to it: "Note sur Seurat et le cadre," Avante-querre 2(1981): 53-59..

[2] Robert Herbert, Georges Seurat: 1859-1881, New York, 1991, Appendix A , p. 376.

canvas--or sometimes on a mat within the frame--before adding a painted frame.[3] An article by Fénéon in 1886, confirms the framing methods of Seurat and some of his contemporaries where they gave up using gold frames for white frames which were kinder to the colours of the painting.[4] Part of the problem of understanding Seurat's intentions with his frames, and, therefore, the role they held within his theory, is that many of the original frames were destroyed and we are left to rely upon comments and reports written by his friends, supporters and critics who had had the good fortune to see the original frames.

An anonymous quote mentions Seurat's working routine: "...he worked six days a week, like a labourer, from nine o'clock in the morning until seven o'clock at night, in that modest, well lit studio on the boulevard de Clichy, which is stripped of all bric-`a-brac, where the studies brought back from a stay by the sea or in the fields radiate in their white frames."[5] This quote gives the reader an idea of Seurat's determination and commitment towards his work, presents an image of his work environment and describes the framing technique favoured by Seurat at that time.

Poseuses was the first canvas to be exhibited in March 1888 with a narrow painted interior frame.[6] There was a pronounced split of judgement regarding Seurat's painted frames and borders.

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[3] Herbert, Georges Seurat: 1859-1891, p. 376, Appendix A. Herbert states that La Grande Jatte and landscapes painted in 1886 had white frames; Poseuses (1887) had a narrow painted interior frame; works in 1888 had borders painted directly on the canvasses; and Chahut (1890) had a gray-blue frame before it was changed to a multi-coloured frame in 1891.

[4] Rewald, Post-Impressionism, 1978, provides this (translated) from Fénéon: "L'Impressionisme aux Tuileries", L'Art Moderne, Sept. 19. 1888. Although this article is not included in his Oeuvres it may be found in F.Fénéon: Oeuvres plus que complétes, ed. by J.C. Halperin, 2 vols., Geneva-Paris, 1970.

[5] S. Faunce, "Seurat and the soul of things", Belgian Art: 1880-1914, Brooklyn Museum, 1980, p. 55, an anonymous quote from L`Art Moderne , 2 March 1980.

[6] See Illstration 8 for an example.

When Pissarro first saw the canvas in the summer of 1887, he seemed entranced by the effect and the possibilities of coloured framing; yet, when Fénéon first saw the painted frame during the exhibit he could see no reason for such a device and attacked such a maneuver as "an absurd reality."[7] While Pissarro was reacting to the overall visual effect and its suggestion of sunlight or shade, Fénéon was reacting to the fact that there was no logical reason for coloured frames and felt that carrying on to such an extent was ridiculous. Even though Chevreul had recommended continuing the harmony of the painting in to the framing process, suggesting this effect and then mastering the mechanics to achieve that effect seemed to be two separate entities.

In both Chahut and Jeune femme se poudrant, the influence of Henry and Humbert de Superville is apparent in Seurat's application of a curved, painted border to create visually-shaped later-style frames.[8] Indeed Henry and Humbert's ideas, which are so obvious in these painted borders, were spelled out in Seurat's esthétique.[9] The curves of the border not only served to frame in the pictorial space but this downward curve also mirrored the upward movements within the painting. These physical shapes fit neatly into Henry's suggestions while the actual physiological adjustment and its subsequent emotional and mental reactions are more along the goals suggested by Humbert. Though it may not seem very pleasing to move one's line of attention in a downward sweep of direction, the fact that both movements are curves, lead

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[7] Both are cited in Herbert, Georges Seurat: 1859-1891, Appendix A. The pertinent comments from Pissarro's letter to Signac are given in full while the review from Fénéon may be found in "Le néo-impressionnisme," L'Art Moderne 8, 16, April 15, 1888, 121-123.

[8] See Illustrations 54 and 58.

[9] See Illustration 59.

the viewer's eye around in a gentle circular movement which was thought to be relaxing and positive.

In addition to the application of frames, painted borders, and shaped borders, Seurat also had the option to vary the size of his paintings and their appearance by using differently sized canvasses. While this option was, of course, open to all artists, the sizes of canvasses which Seurat used seem to indicate that another factor may have influenced Seurat's choices.

The table in Appendix H shows the standard sizes of canvasses which were sold on the market from 1850-1890 in France. As today, the canvasses were pre-stretched and primed, all ready for use. The sizes were quite specific yet few of Seurat's canvasses were anywhere near these standard sizes. One might expect slight deviations due to canvas edge deterioration, reframing or his later addition of painted borders, but the measurements of Seurat's canvasses seemed too different for any of these to have been the case. The majority of the canvas sizes did not fall into similar-sized catagories, they were an exception rather than a rule when it came to matching sizes.

When I compared at the sizes of Seurat's canvasses, only about one out of every fifteen "fit" the above list of ready-made canvasses. Seurat's drawings had been done on either small individual pieces of rag-rolled paper or had been cut into quarters from one larger size of paper which suggested that he had no hesitation in creating the size he desired from what was available. Considering this, it would be logical to say that he must have had most of his canvasses custom-made. Curiously though, Seurat's reason for the variety of the canvas sizes

remmains unclear and there seems to be no written explanation for the disparity of his canvas sizes from those which were mass produced.

There has been no citation regarding the size of Seurat's canvasses and any role they might hold within his theory, yet the observation of his canvasses failing to "meet" the standard measurements offers support, in a back-handed sort of way, for only one argument; namely, Seurat could not have used the Golden Section or any other formula to "size-up" and produce a painting. If he had, surely his canvasses would exhibit a proportional expansion rather than the haphazard shrinking and lengthening which exists.

With the variations of completely white frames or multi-coloured spotted frames, painted borders (whether on the canvas or on an added matt), shaped borders and a variety of canvas sizes, Seurat had given himself the widest array of options regarding the presentation of his works. In an approach to art which seemed to have as many variables as Seurat's did, it is soothing, in a way, to know that he had enough control of the technical side, through the manipulations of the above options, to allow for what he deemed the best presentation possible.

La Parade de Cirque (1887-1888)

It should be clear by now that nothing regarding Seurat, his works or his theory is as simple as it might appear; there is nothing cut-and-dried about anything associated with the man. He did not strictly apply the findings of some scientists to the exclusion of everything else; he did not apply billions of precisely sized and shaped spots of colour to his canvasses; he did not throw away his art training for some mathematical formulae; in short, the only thing black-and-white about Seurat were his drawings. Ahem. For Seurat, there is only one word which best applies: "Synthesis". He was working out his own theory with the aid of outside influences, creating, adjusting, and continuously synthesizing the mass of information he had gathered.

Rewald feels it was "Seurat's conception of art rather than his purely technical innovations that was the decisive element of his contribution."[1] Perhaps this is the case; Seurat may have approached the task of creation as if he could view things from several points at once: the artist's and the observer's and the scientist's. With respect to such technical matters concerning Seurat, John Rewald is an immensely valuable witness because of his first-hand experience with contemporaries of Seurat.

Rewald had the good fortune to be able to spend time with Fénéon and study his collection of reviews; he spoke with Paul Signac and Maximilien Luce; he saw Lucien Pissarro and received a stack of Camille Pissarro's letters from him; and from this, was able to uncover to further commentary between Seurat and Signac

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[1] John Rewald, Seurat: A biography, London, 1990, p 11.

as well as some correspondence between Signac and C. Pissarro.[2] I have not had such opportunities and, indeed, with the passing of some 60 years, chances of such encounters are now long-gone.

The only first-hand contributions I can offer to the body of research on Seurat are the results of my intensive viewing of Seurat's canvasses, when I have been prepared with what knowledge I could garner about Seurat's techniques and ideas. My training has been in science while I dabble in free-lance artwork, Seurat was just the opposite; ideally, this intriguing partnership of interests might reveal some new insight and help to further correct misinterpretations from the past. Regardless, of the outcome of my investigation, this next section will introduce Seurat's last five major pieces.

Parade de cirque was painted in 1887 to 1888 and is Seurat's impression of entertainment from a band and circus sideshow at night.[3] Since it was a night scene and he could not work outdoors, he had to work quite hastily to capture what he recalled of the scene on canvas. Broad areas of colour were quickly blocked in before dashes and dots were used to define the subjects more clearly. Seurat had to rely upon his memory of the colours while also keeping in mind the visual effects and illusions he wanted to emphasize. Thus, the canvas became a physical representation of "...a cerebral synthesis of natural appearances..."[4] and, in effect, this canvas was "...derived from an intellectual amalgam of theory and memory."[5]

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2 Rewald, Op.cit., p. 15. His work was begun in Paris in the late 1930s.
3 See Illustration 9.
4 Richard Thomson, Seurat, Oxford, 1985, p.152.
5 Thomson, Op.cit., p. 148.

While this canvas certainly does represent some physical depictions of visual phenomena Seurat had observed at nighttime, and he would have had to rely upon his memory for colour being quite accurate in order to dutifully replicate what he had seen, I do not know that I would place such strong emphasis upon the influence of Henry, at this time and on this canvas, as Thomson, and others, have done.[6] Entertainment, to me, means amusement found in diversions while circus entertainment adds the factors of gaiety and a childlike wonder. Seeking such circus entertainment at night, in the 1890s, however, pulls in another aspect, something akin to voyeurism tinged with an almost illicit flavour as one peeks into a lifestyle which is unnatural sometimes to the point of being macabre. With emotions and feelings of lightheartedness, gaiety, relaxation, expectation, curiosity, fun, and a slightly sinister aspect thrown in for good measure, how can the primarily horizontally-lined and rectangularly-segmented canvas of Parade de Cirque be seen as a graphic representation of Henry's ideas? Parade de Cirque is not a natural scene. It is not easy to read because of the segmentation which causes the viewer to feel disinterested and uninvolved. For Henry, horizontal lines indicated calmness while subdued and sombre tones meant serenity. I fail to see any correlation of such messages with this canvas.

Apparently Seurat's contemporaries did not see any evidence of Henry's influence on this canvas, either; in fact, not until Chahut and then Cirque were exhibited did Henry's theory become

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[6] Herbert has suggested that Seurat's architectural composition is based upon Henry's Esthétique even though the critics at the time questioned the degree of influence Henry had upon Seurat. See mention made in John Russell's Seurat, London, 1965, p. 216.

firmly linked with Seurat's canvasses.[7] Tinterow offers other explanations for what may have inspired Parade de Cirque by citing literary sources or suggesting the work was a possible outlet for societal criticism and adds that the lack of caricatured features in the people in Parade de Cirque is evidence that some message was intended from Seurat.[8] I cannot say with any authority what literary sources may have influenced this canvas, but I would like to suggest that the lack of features--not even in caricature, but almost non-existent features--provides one of the strongest arguments against Henry's influence upon Seurat at this time.[9] Faces depicted in accordance with Henry's theory--which would have been similar to Blanc's theory as it was influenced by Humbert de Superville--would be simplified with an exaggerated emphasis on the direction of the features of the eyes and mouth in particular.[10] Since line would suggest emotion, indication of facial features would have to be an essential and not an optional extra.

It is possible that this canvas represents a basic dilemma of Seurat's work and how we view it? Could it be a case of he tried "X" and he failed "X"; or, is that too sweeping a generalization? He had so much he wanted to incorporate, to synthesize, how could he have included everything at one time and

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[7] Gary Tinterow, "Parade de cirque 1887-1888" in Herbert, Georges Seurat: 1859-1891, 1991, p. 309. Tinterow elaborates and cites a quote from Theo van Gogh in a letter to his brother about Seurat's Chahut, mentioning expressing things through the direction of lines, a sure indication of Henry's theory. Gary Tinterow is the Engelhard Associate Curator in the Department of European Paintings at the Metropolitan Museum of Art and was one of the key organizers of the 1991 Seurat exhibit.

[8] Tinterow, Op.cit., p. 311.

[9] John Russell, Op.cit., p. 218. Russell suggests that Seurat had read Rimbaud's poem entitled Parade and was agreeing with Rimbaud's impression that circusses were a "...mirror to the condition of mankind in the new-made industrial cities..."

[10] See p. 198 for facial schema as recommended by Blanc.

in a successful manner? Perhaps he tried "X" and it was the actual process of trying and the teasing out the effect which intrigued Seurat. From our discussion on harmony and the Symbolist and Wagnerian influences, we know that it is the active process which is the goal and the reward, not the static end.

The overall feel of this painting is cool, the late night air has a chill on it and the light has faded. The scene is speckly, there is not quite enough light for distinct colours and the eye tries to fill in what the brain knows should be there. Though we strain to see clearly, our eyes have not yet adjusted to the changes even though some things are illuminated by the glow of a gas light. The colours of blues, greens and purples flicker across the surface as the light's intensity changes; yet, even underneath the warmer oranges and yellows of the gas light, the chill remains.

These colours permeate the canvas and fail to respect subjects or areas; all are treated alike. Though the centre panel, which is the most brightly lit area in the entire scene, is a deep apricot colour, it still has a coolness about it that keeps it in line with the rest of the canvas. Even the light from the gas lamps is ultimately cool and feeble, the orange from the light is trying to get through the darkness of the night with little success and is ringed-in with purple not very far from its source.

The right side of the canvas is more blue-green than the rest of the painting and this is apparently due to the fact that Seurat was depicting part of the performer's stand which was recessed and further back than the other parts. He abandoned the typical methods of foreshortening or size changes to indicate

objects in space and chose, instead, to use lighting and the changes in colour.[11] Perhaps his selective and careful use of colours to indicate lighting changes would have been too much if he had also employed scale changes; then again, he would have lost control over his geometric and relief-like figures if he had used perspective. This harkens back to the situation in La Grande Jatte where the figures are out of proportion with each other yet the final effect is of a stately sort of grandeur and monemental permanance.

Thanks to an in-depth analysis of the painting at The Metropolitan Museum of Art, Gary Tinterow has been able to provide a clear and assured description of Seurat's paint application procedure on this canvas. The three stages of paint application are: 1) warm violet-gray tones and cooler blue-gray tones were brushed into the shapes which had been sketched out in blue lines on the prepared white canvas surface; 2) larger dots--which rarely conformed to the contours of the figures--were applied in dark violet-blues, oranges and greens; and, finally, 3) smaller dots, either in the colours used in Step 2 or their complementaries were applied to indicate tonal qualities and to provide for some figure definition.[12]

The colours of objects in the background are almost indiscernable due to the intermingling of the darker, cooler colours. While the colours of objects in the foreground are slightly easier to pick up, they are still done in a limited range of light-purples and yellowy-greens, and the final effect is a neutralized tone. Homer agrees that this division of tone

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[11] Tinterow, Op.cit., 1991, p. 305.

[12] Tinterow, Op.cit., 1991, p.309. See Herbert, Georges Seurat: 1859-1891, p. 311 for a detail of La Parade.

and partial optical mixture across the canvas ends up producing a "...wide range of luminous neutrals."[13] This luminosity from both the intermingling of tones and colours maintains the visual uncertainty as even the subjects' contours seem to shift. The nature of the nocturnal scene, being lit by gas lamps, lends itself perfectly to a chance to achieve a great degree of luminosity; Seurat perfectly affects the sensation of inadequate lighting and the continuing struggle to see something clearly.

For example, the shirt, tie and hands in the second major figure from the right are smeary looking by comparison to the rest of canvas.[14] Seurat's technique of background colours with successive layers of dots is concisely delineated except for this young man's clothing. The tie, shirt et al. look milky-blue, as if the colours were physically blended or have reacted due to some chemical interaction. Even under close inspection, I could not make out separate and distinct dots or strokes. The only thing I could think of was one of Seurat's earlier drawing techniques; the visual feeling is reminiscent of the rubbed out smeary and silvery parts in drawings where Seurat had wanted to indicate highlights or light hitting a different surface texture.

John House has offered a possible interpretation regarding this figure with the smeary clothes. He feels that this small man is an artistic intervention of Seurat's; this figure invites us into the scene while simultaneously keeping us at arm's length.[15] This figure is the only one of the performers who is looking at another figure; it is if he is waiting for the

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[13] William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 178.
[14] See Illustration 60.
[15] John House, "Seurat and the Politics of the Avante-Garde", The Metropolitan Museum of Art, New York seminar, 4 October 1991.

conductor to give him some signal. If this is the case, and the viewer plays a similar role to that of small man, we are waiting for Seurat to give us some signal and to clue us in about what he means.

The trombonist wears a white shirt yet his clothing is depicted with the dots as we expected Seurat would have created. Even with Seurat's process verified through Tinterow's analysis, we still do not know why this strange effect has been used on this young man. Even if this figure were dressed in pure silk, surely some other method could have been employed to impart that smooth surface sensation. The man in the centre foreground wears a silk top hat and it looks shiny and it is depicted entirely with dots.

Perhaps the most curious aspect about this mysterious painting occurs when one stands about six feet away from the canvas and looks at it for a long time; new visual phenomena begin to become apparent. A strange effect soon begins to draw the viewer into the scene, one feels that it is dark and the only light is coming from the gas lamps. One tries to see distinct and clear objects but they refuse to emerge from the duskiness, they remain hazy and indistinct. The longer one views this piece, the more one becomes convinced that twilight has descended and an impatience develops while one's eyes "adjust" to the gloom.

Even an increased viewing distance does not forestall these effects, it just entails a slightly longer viewing time before the twilight gloominess begins to take over. I tried this time and time again in the brightly lit and spacious gallery at The Metropolitan Museum of Art in New York and ultimately, I was

drawn into the canvas. Peripheral movement, light and colours ceased to impinge upon my consciousness as the scene, and particularly the lighting effects, within La Parade became more conspicuous. Continued viewing of anything will cause peripheral matter to fade away and I became convinced that Seurat also knew this and made this a key step in his visual game.

Seurat has depicted the entire scene as if he had viewed it out of the corner of his eye. The entire painting has the feel that one has glimpsed something but is not quite certain just what it was that was seen. Even though a viewer focusses steadily upon the canvas, this will-o'-the-wisp fanciful viewing sensation remains.

Viewing an object out of the corner of one's eye at night is the only way to see it distinctly because directly focussing on something will push it into obscurity if not make it vanish completely. For example, the only way to view a faint star is to look just slightly away from where it is really located since a direct stare at its actual location will make it impossible to see, it will "disappear". This is a known and proven physiological phenomena, which occurs when viewing is mediated by rods rather than the more normal cone-mediated viewing during brighter lighting conditions, and it will be discussed in greater detail in Chapter 6. For now, let it again suffice to say that I am convinced that Seurat knew of this phenonmena. He may not have known of the mechanisms which operated it, but he knew enough to create a fair replication of the sensation; the more we look at objects on his canvas, the less clearly we see them, we must look just away or glimpse them to get a better view.

The last effect I wish to mention concerns a wonderful discovery about the canvas which Tinterow describes.

> Recently, when the painting was examined at the Metropolitan Museum's laboratory in light similar in color to that given off by gas lamps, an extraordinary transformation took place. Under the colored light the faces of the figures on the platform no longer appeared unnaturally orange but flesh color, the shadows on the trombonist and on the spectators were no longer bright ultramarine blue but black, and the entire painting glowed as if it were lit from behind, which, of course, is precisely the effect of contre-lumiere on which Seurat predicated the picture.[16]

This discovery brings to light something which has always intrigued me about Seurat's work. For an artist who worked compulsively to depict colours accurately under varying lighting conditions, how can any observer expect to be satisfied viewing the finished piece under one sort of light and from one position only? I have never been satisified with lighting and viewing conditions wherever I have seen Seurat paintings; I have always wanted more and certainly have wanted the chance to experience variations with light sources. The changes as described when Parade de Cirque were viewed under light similar to that produced by gas light make perfect sense and would have been wonderful to see.

Not only could Seurat have been painting a scene in order to take advantage of the gas lighting in a gallery where the finished work would have been viewed later on, he could have been presenting us with all but the ultimate step of his visual game; all of the pieces were there but without the final and proper light and viewing conditions, the magical effects would not appear. Perhaps some of these reasons may help to explain why

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[16] Gary Tinterow, Op.cit., 1991, p.306-308.

his paintings were so slowly accepted; people couldn't experience the full effects unless they worked to wrest all they could from the visual matter. Everything was there but Seurat's public did not know how to read his works; because, without the magic decoder ring, his secret messages lay untouched.

Poseuses (1888)

Poseuses was the first major nude figure study by Seurat undertaken in a pointillist technique. Until Seurat undertook this painting, the general feeling from Seurat's critics was that such a technique would not willingly lend itself to representing soft, smooth flesh tones even though Fénéon had stated in 1884, "...the pointillist technique is clearly superior for the rendering of smooth surfaces and, in particular, for the nude, a subject to which it has not yet been applied."[1]

The male nude and his setting had constituted the most serious challenge to the aspiring artist while the setting of the nude usually was of some classical pose involving an heroic act. Good paintings of male nudes showed off an artist's knowledge of anatomy as well as his painterly skills in bringing together a scene which was classical yet not remotely suggestive; all the gods did manly things and all of them did it mostly unclothed with muscles rippling. Good paintings of female nudes, however, were not as numerous and the subject matter usually involved some myth or allegory with the subjects being modestly draped with gauze or flowing garlands.

It was not until the 19th century, when some artists began to depict the nude in a different manner, that the viewers were forced to confront the issue that an unclothed person, usually a female, was standing in front of them. Renior's women were shown bathing or combing their hair after a bath, Degas showed women at their toilette, and Manet's Olympia revealed a member of the oldest profession in the world; no longer were female nudes nebulous sea nymphs arising from the mists, reality had struck.

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[1] John Russell, Seurat, London, 1965, p. 182.

A new relationship between the models, the artist and the public had begun. Now the artist had a new challenge, to prove himself through the stark depiction of a beautiful body of a young female nude and to do it in a realistic setting while hoping the public would not rebel too vociferously.[2]

Seurat painted Poseuses during the time these changes were evolving and chose to use working women as models in Poseuses. He did not tie them to nature through allegory or via their setting; instead, he just painted these women who seemed to have divested themselves of their garments in his studio as if by accident; only the woman in the centre is actually posing. We are presented with a scene where we almost feel apologetic for catching a glimpse of someone who has just disrobed; even though the title indicates that the scene has been planned and we know that they know they are being observed. The fact that the women are thin, working women, and not particularly beautiful, makes their very presence all the more equivocal.[3]

In addition to depicting the female nude in his controversial manner, Seurat also drew upon the theoretical considerations from Henry regarding colours and lines in this canvas and its études.[4] Although it is now believed that Seurat made conscientious use of Henry's theories, the fact that he also used a different gesso ground for the final canvas makes it

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[2] Nochlin, Linda. "Body Politics: Seurat's Poseuses and the Problem of the Nude", seminar, 18 October 1991 at The Metropolitan Museum of Art, New York.
[3] Nochlin, Ibid., 1991. She speaks of the women being Jewish but I feel this is reading too much into the stylized figures.
[4] Richard Thomson, Seurat, Oxford, 1985, p. 144. Thomson suggests that it might prove beneficial to see if the red, yellow and green that Seurat used in the two parasols and green stockings match up with Henry's chromatic circle positions while Russell (1965, p. 203) had indicated that they are the colours from Henry's chromatic circle. House (1980, p.351) however, wryly notes, that if Henry's theory were taken literally, Seurat would have painted "two happy parasols, and one rather sad stocking"!!

difficult to assess the works' outcome since the gesso caused the colours to be altered from their original state.[5] These reasons, in addition to the expected colour changes from the initial application, must keep us wary about reading too much into a work which is purported to have been based upon a colour theory and then abetted by an aesthetic approach; even if the work is a key representation of a change in Seurat's style.[6]

Poseuse de face of 1886 is an incomplete and a very quick study which looks as if some masterful confetti artist skillfully dropped variegated pieces of paper down into a passable representation of a female figure facing the viewer.[7] Although the work is dated 1886, the quickness of style and general patchiness of the paint application, which allows the wood's veneer to show through, is more typical of some of Seurat's earlier works. The brushstrokes are broad as if he used a flat brush, slightly twisting it for smaller flicks of paint. There is a strong blue aura around the figure which ceases rather abruptly on the right and blends better on the left before it becomes a pinky-peach aura. It is just possible to tell that the figure is a young girl but her features are non-existent. Strangely, as Seurat progressed with the studies towards

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[5] Thomson, Op.cit., p. 141. Francoise Cachin, "Poseuses 1886-1888" in Georges Seurat 1859-1891, Metropolitan Museum of Art, New York, 1991, p. 278-9, adds that the surface of the final canvas was coated with plaster--to provide a white surface for Seurat to paint upon--which altered the colours and changed the drying time. Many corrections and changes were required as a result but the "closed-doors" policy of the Barnes Collection means that this canvas was not examined in detail--until 1993.

[6] Since the time I began this research, the Barnes Foundation has allowed the public greater access to its collection. A touring exhibition of its treasures progressed from Washington, D.C. to Paris in 1993 and then went to Tokyo before returning home in mid-1994. I was not able to witness the exhibit firsthand and, again, had to rely upon the catalogue and articles written about the exhibition. The history behind the Barnes collection and this momentous exhibition is discussed in Appendix H.

[7] See Illustration 61a.

Poseuses, the figures, especially the central one as depicted in this canvas, gained individual characteristics rather than losing them.

In contrast to this first study, Poseuse de face (1886-1887,signed LR, "Seurat") is a very complete study done in pointillist techniques with a painted border--on the canvas itself--which was added in 1890.[8] Herbert mentions how the panel was done in two stages with larger strokes serving as the background for tinier strokes which were added some months later.[9] This panel was done and then exhibited after two other studies, Poseuse de profil and Poseuse de dos, were completed but never shown. Apparently Seurat planned to exhibit this study which may help to explain the intricacy of the strokes and the deliberate placement of every spot of colour found in this work.

The colours used are the same as for the other canvasses but the overall feel from this piece is cool since the pale blue colour predominates. Even though the figure is warm by contrast, there are still pale blue dots over most of her body and there is also a distinctive blue outline around her contours.

One of Seurat's unexhibited studies, Poseuse de profil (late 1886, painted border) looks complete and is very pointillistic in style with its added border of mostly blue strokes.[10] This piece seems to have at least two stages; the first of balayé strokes to lay in the colours and block out the shapes, such as that found on the stool and the material at the model's feet, and the second stage of smaller dots to define the image further. Herbert

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[8] See Illustration 61b. This border was not shown in the 1991 catalogue even though the summary indicates that the picture was retouched in April-May 1890. (Herbert, Georges Seurat: 1859-1891, p. 283.)

[9] Herbert, Georges Seurat: 1859-1891, p. 283.

[10] See Illustration 62a.

agrees and mentions that photographic analysis reveals an another, initial stage of longer, criss-cross strokes before the darks and lights are set in, with the final stage being the dotted top layer.[11] The basic colours are pinks, lighter blues and golden tones; darker sorts of orangy-browns are sprinkled over the whole painting which, with the veneer of the wood showing through, unifies and warms up the whole scene. There is a pale blue outline around the model which could have been guidelines used by Seurat. The overall tiny size of the dots and the large, floaty halo around the seated figure gives an impression of lightness through pastel tones even though stronger colours have been used in this study.

Seurat also painted Poseuse de dos in late 1886 and this, too, is a very complete work and done in a lovely pointillist manner.[12] The background in this study is not atmospheric as in the undefined backdrop shown in Poseuse de profil. Rather, the background in Poseuses de dos is definite with large and bold dots since it comprises that of the canvas of La Grande Jatte which is hanging on the wall behind the model. Though the model has substantial weight and volume, Seurat used such delicate strokes and light colours one ceases to be aware of her size. Squinting one's eyes makes the image more cohesive as the figure transforms itself into a classical pose which is so Ingres-like that I wonder why Seurat failed to exhibit this piece.

The colours on the model are pinks and pale blues with discrete usage of warmer oranges to offset the increased blueness in the curves and shadows of her body. The background colours

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11 Herbert, Georges Seurat: 1859-1891, p. 286

12 See Illustration 62b.

are much warmer and livelier with oranges, greens, some reds and blues providing an indication of La Grande Jatte and the walls and floor.

It is interesting to note that although Fénéon proclaimed a pointillist technique would be ideally suited to nudes, Signac, in direct opposition, felt that the technique detracted from the final effect by making the whole painting disagreeable and mechanical.[13] With a correct viewing distance, or by squinting one's eyes, this simply is not the case; Poseuses de dos is classic, serene and enjoyable. Yet, of all of Seurat's series concerning the models, only the smaller version of the final arrangement, with its freer brushstrokes, was deemed agreeable by the critics of the time.

Poseuses, petite version, 1888, was painted either after the final canvas was done in 1888 or during the time Seurat was working on the final canvas in 1887; apparently the problems Seurat was having with the gesso-coated canvas of the larger version made him turn to a smaller version to try to work out his difficulties.[14] Although this is the smaller canvas, it is the one which the world has come to recognize and associate as Poseuses.

The luminous images on this canvas are much more abstract than those shown in La Grande Jatte and even though each small spot of colour in Poseuses is quite intensely coloured, the overall effect is quite lustrous.[15] Homer describes Seurat's process on this canvas in two steps: First, Seurat modelled the figures monochromatically to achieve a three-dimensional effect

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[13] See opening discussion and Signac diary, Dec. 29, 1897; see Extraits du journal inédit de Paul Signac, I, Gazette des Beaux-Arts, July-Sept, 1949.
[14] See Illustration 8.
[15] William Homer, Seurat and the Science of Painting, Cambridge, 1964, p. 171.

via tone modulation; and, next, he modified the hues according to light and shadow and neighbouring colours.[16] The result is a combination of chiaroscuro effects with the bonus of colour differentiation; new tones are created as both the values and the colours join in a partial optical mix. This follows the procedure which both Chevreul and Rood had long advocated; that of mastering value relationships before concentrating on colour. Seurat's proven skills with drawing and his increasing facility with colour have come together beautifully in this canvas.[17]

When one considers the incredibly methodical and determined nature of Seurat, it seems highly implausible that he "just happened to paint" the models in front of La Grande Jatte which "just happened to be" hanging on the wall. Some scholars have mentioned this curious juxtaposition and have suggested various interpretations regarding Seurat's comments on society's class divisions.[18] The monkey in La Grande Jatte has been interpreted by some as a sign of the main female figure's loose morals, and it is Russell who best reinforces this interpretation by suggesting that it was no accident that, "...the rounded and tender back of the nude on the left should blot out the symbolic monkey and its emblematic tail."[19] Whatever the real meaning intended by Seurat, whether overt or covert, there is a message contained within this "real" world scene of the studio and the created world of La Grande Jatte.

Linda Nochlin, a professor of Art History at Yale University, was able to gain entrance to the Barnes Collection

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16 Homer, Op.cit., p. 167.

17 Homer gushes about Seurat's "perfected chromo-luminarist technique in Les Poseuses" (p. 174) but that may be going a bit too far.

18 Russell, Op.cit., p. 201.

19 Russell, Op.cit., p. 206.

and was allowed to see Poseuses. In the past, Poseuses was difficult to see, not only due to limited access to the collection but also because of the canvas's location high up on a wall. Furthermore, the canvas can never be moved for exhibitions or photo sessions and its awkward high placement disallows any chance of obtaining good colour reproductions.[20] Even with all of these obstacles, Nochlin's intense scrutiny of Poseuses revealed some interesting "discoveries", which are not so readily visible in the existing reproductions.

Firstly, La Grande Jatte is painted quite accurately; items are reproduced one-to-one, as if La Grande Jatte were hanging on the wall of the studio while the models posed in front of it and someone took a photograph of the entire scene.[21] However, Nochlin happened to notice a slight variation in the handling of the little brown dog in the foreground of La Grande Jatte; he jumps at a butterfly in the original canvas, but is now jumping at the bow on the parasol which rests against the wall in the studio of Poseuses![22] Seurat has, with judicious juxtaposition, neatly conjoined the two scenes with this visual trick, and one expects the little dog to jump out of La Grande Jatte into Poseuses as soon as the magic word has been uttered.

There were other instances of interplay between the two scenarios. Seurat's stylized umbrellas, with their very feminine bows and gegaws represented another visual connection: every

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[20] Nochlin, Op.cit., 1991. Ms. Nochlin's viewing of this canvas was before the 1992 court decision to "open-up" the accessibility to the Barnes collection and allow the loan and subsequent tour of 80 key pieces; Poseuses is one of the major works on exhibit.

[21] Cachin, in Herbert's Georges Seurat: 1859-1891, 1991,, p. 278. Cachin noted that the red parasol and hat in the studio seem to be from La Grande Jatte but seems to aim this remark along the lines that Seurat was carefully building up his composition and including certain visual ties between the two scenarios.

[22] Nochlin, Op.cit., 1991.

single item of feminine accoutrement, from shoes to gloves and umbrellas to hats, which is strewn about the floor and furniture of Poseuses, resided originally in the canvas of La Grande Jatte.[23] Nochlin states that it as if some of the suitably dressed and fashionable creatures in La Grande Jatte have entered the studio and removed all of the trappings their society deemed correct. We wonder now if the uncomfortable and stiffly grouped clothed figures in La Grande Jatte are more acceptable than the caught-out, yet quite natural and unclothed figures in Les Poseuses. Seurat's use of irony makes us stop and think about how a society judges what is correct.

It has already been mentioned that the subject matter of this canvas, the nudes, had the original purpose of showing the world that the pointillist technique would work especially well for flesh-tones. Seurat took the models and flattened them, emphasizing the contours as Ingres would have done in order to give the models added stature and dignity as they stood in front of the very different scenario of La Grande Jatte. The question of nature and artifice is reinforced with the juxtaposition of Seurat's two canvasses: the figures in La Grande Jatte are stiff while the poses of the models are presented au naturel; even so, the models are unnatural by their unplanned positions.[24] In other words, the models' purpose for being there remains unexplained; they do not feel "natural" divested of their cover and, with the exception of the central figure, none are posing for the artist.[25]

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[23] Nochlin, Op.cit., 1991. This was also been noted by Cachin, Op.cit., 1991, p. 278 and I do not know who should receive credit for the original identification since each scholar cites the other in her writings and talks.
[24] John House, "Seurat and the Politics of the Avant-Garde", seminar, The Metropolitan Museum of Art, New York, 4 October 1991.
[25] Nochlin, Op.cit., 18 October 1991.

The contradictions felt in this canvas might be labelled as art against artifice, real against created, naive against experience or moralistic against a laxness of morals. Whatever the labels, and despite what appears to be great visual naturalism, there is a conflict in the very label itself: Poseuses. The fact that Seurat made the title "Poseuses" is significant for French speakers; rather than using the more common word "pose" or "modele", "poseuses" means "one who, out of vanity, seeks to attract notice by an artificial or affected manner".[26] The title may refer to the models, or the finely clothed people in La Grande Jatte, or to the contrast between the two scenes; we cannot be sure exactly what is meant.

Nochlin's two other observations concern colour effects. First, she believes that the orange polka-dots on the blue skirt in the foreground of Poseuses serves as a visual pun on pointillisme; it is "dots-doing-dots" and repeats the idea of a thing-within-a-thing which began with Seurat painting a painting of his painting.[27] Secondly, Seurat extends his colour scheme from La Grande Jatte into Poseuses by picking up the predominant green of La Grande Jatte in the green stockings and green bag of Poseuses, for instance.[28]

La Grande Jatte was begun in 1884 when Seurat still used his directional brushstrokes to define form rather than for their emotional effectiveness. His colour combinations in La Grande Jatte were also used primarily for their optical effectiveness rather than to elicit any emotions. With the application of

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[26] Cachin, Op.cit., p. 273. She makes this connection from checking late 19th century dictionaries, adding that "poseur" was first used in English in the 1870s with the same connotation.
[27] Nochlin, Op.cit., 1991.
[28] Nochlin, Op.cit., 1991.

Henry's theories becoming apparent in Poseuses, I wonder whether there is a sense of the brushstrokes and, more specifically, different coloured brushstrokes, going in specifically expressive directions in the La Grand Jatte part of Poseuses. This would indicate whether the techniques which were originally used in La Grand Jatte changed when La Grand Jatte was depicted in Poseuses. This query remains unanswered at this time.

Lastly, in this visually contrary canvas, there are problems in space and perspective. The lines from the floorboards and the skirting boards, as they recede in space, fail to meet up with what appears to be the corner of the wall; the skirting board lines meet directly behind the central model and not to her right where another line is situated. Although this line on the wall does help to frame in the model on the far right and, indeed, it appears a perfect accent to offset her flat two-dimensionality, it still provides a visual contradiction when read in the context of the entire scene. This new visual contradiction forces the viewer to work to get an accurate reading and "..active perception rather than passive reception of the visual evidence"[29] is required. This sounds like one of Seurat's favourite themes and provides more support for his "Visual Games" approach to his developing theory.

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29 Mochlin, Op.cit., 1991.

Chahut (1889)

By now, in the late 1880s, Seurat's sense of irony was so well-established and his colour theory so firmed up that he didn't need to experiment with umpteen variations before attempting final version of a canvas. He could present a subject in the colour and style he thought best, make full use of input from Henry et al. and rest secure in the knowledge that most of his ingredients were choice. Therefore, as Seurat's career progressed, he required less studies to determine the layout for his final paintings. Signac recorded in an inventory that Seurat painted just four studies for Chahut on wooden panels but, of these four, only one remains.[1] I was able to study the remaining wooden-support étude closely at the Courtauld Institute. Étude pour "Chahut" (1889-1890) was based upon the drawing, Au Divan Japonais (1887-1888), done at random by Seurat which he later decided to work up into a painting.[2]

The border is wide, and only three-sided; there is no painted border on the right hand side. It has been suggested that Seurat may have added a painted strip of wood to provide the fourth side of the border but the picture as it stands, with only three sides bordered, is the same width as most of his other panels; I have come across no explanations for this strange way of handling a picture.[3]

Dark and light blue colours predominate in the border which remains and the paint is a smudgey, gooey blue that has streaked with more blue being concentrated on the edge of each stroke; this lightens the appearance of the center of the stroke. The top

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1 Herbert, Georges Seurat 1859-1891, New York, 1991, p. 346.
2 See Illustrations 63a and 63b.
3 Herbert, Georges Seurat 1859-1891, p. 347.

and left borders are comprised of red and blue dots, although most of the blue dots blend together to form a rather solid strip of colour; it is only the red dots which are distinct spots and can be seen to overlap strokes on the previous layer. The left hand side border has red dots integrated with the blue coming down from the top until it meets the line created by the conductor's head. Then, abruptly, the red dots cease. The bottom border is almost a solid blue bar with only a faint indication of the dots here and there which should have comprised it. The inner border is accurate in the colour usage for the theory on all sides except the left hand side.

The brushwork on the figures duplicates techniques Seurat had tried before; the groundwork has been laid down and then covered with layers of dots. The first layer of dots is very directional and looks like  on the upswing of the first dancer's skirt, for example. The second layer of dots is less directional and the dots are rounder yet the straps of the lead dancer's bodice and the bodice itself are laid-in with thick blue brushstrokes and have very few covering dots. All of the figures have an aura of orange around them, like a powdery orange cloud, which fades into the gloomy non-defined background not far beyond their contours. The upper right hand side of the canvas, just above the male dancer's face and through the last dancer's hat and on into the corner, is heavily impasted.

The size of dots generally ranges from  to  . Strangely, though, for the size of the study, the dots seem large and choppy and never really blend together until quite a viewing distance has been reached.

The figure in the lower right-hand corner, whoever he is, is definitely outlined in blue lines. Was this an original lay-in of the blue which Seurat failed to cover? No dots, whatsoever, cover this line or any of the other lines which continue down to form both of each dancer's legs. Also, there are lines apparent on the conductor's arm, underneath his baton, at his wrist and on his hairline. There is a very faint line in the fold of the first dancer's skirt which travels down from her high-kicked leg; this could be one of the pencil lines mentioned in the Courtauld catalogue; the other pencil marks are in her face. However, I am not sure that Seurat intended to change things or elaborate further areas as is suggested by the Courtauld.[4]

Viewing this study from a distance of 10-12 feet allows very pleasing graphic qualities to come through since one sees shapes rather than detailed figures. The colours seem mossy green, dark apricot and burgundy-blue and almost brown in places.[5] The light fixtures look like free-hanging tulips, without purpose or identification. The dark areas immediately adjacent to the lights do not support the normal idea of light going out from a source. Rather, the light seems to be brightest in the tulip-shaped lamp itself before it skips over its immediate surrounds, which are a very dark blue to emphasize the brightness from the light, before it then radiates outwards to fade away into the gloom.

Another study for Chahut was included in the New York exhibition in 1991 and this Étude pour "Chahut", done in 1889-90,

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[4] Impressionist & Post-Impressionist Masterpieces: The Courtauld Collection, 1987, entry 35.

[5] See Illustration 64a.

was done in oil on canvas and measures 55.5 x 46.5 cm, almost twice the size of the Courtauld étude on wood.[6]

The most noticeable feature of this study is a 3" wide blue painted frame around a painted inner border on the canvas and the canvas border seems darker than the framed one. The paint on the frame has strokes which are elongated and very much larger than the smaller, and generally more rounded strokes, used on the canvas. The blueness of the frame helps to emphasize the overall blue cast of this canvas; this is different from the previous study which didn't seem "blue" even though that was a predominant colour. Herbert feels that the frame is probably Seurat's. The pigments and colour presentation are similar to those on the canvas, yet it is not possible to authenticate it positively; the frame may be a replacement for the original or simply done in a style similar to Seurat's.[7]

The bottom painted edge of the canvas, on the left hand side, ripples quite noticeably. I have been unable to discover whether this was due to re-stretching of the canvas at some point in time or whether the painting was re-framed and possibly damaged. The colours on the corresponding part of the frame seem extremely dry and lifeless and I wonder whether the painting was placed too near some source of heat at some time in its life; this could have dried out that corner, dulling the frame's colours and distorting the canvas.

The strokes on this canvas have been compressed and multiplied since the earlier study done on the small wooden panel. Details have been added to emphasis the folds of fabric

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[6] See Illustration 64b for a b/w reproduction, Illustration 65 for colour.
[7] Herbert, Georges Seurat 1859-1891, p. 348. See previous section on Frames and Borders for further commentary on this.

and the musician's faces; indeed, their bodies are now visible in the gloom. Colour mixtures have become more complicated since the tinier dots allow for greater interplay within a given space. The overall colour scheme remains bright and lively even though the dots are more precise and uniform than those in the first study. Unfortunately, as with studies for Une Baignade and La Grande Jatte, the final canvas loses some of this vitality in the transition from the studies.[8]

The final canvas Chahut was shown at the Société des Artistes Indépendants exhibition in the spring of 1890 where it received much discussion from the Symbolist critics especially because of its purported use of Henry's theories [9]. Visually, there do appear to be a "...profusion of references which could have been devised by Charles Henry himself."[10] Seurat's use of bright, warm colours and upwardly curving lines were meant to represent gaiety and his stylized characterization of the figures embodied the antinaturalist ideas of Blanc, both aspects of which were fully supported by the Symbolist group. Herbert correctly acknowledges that, although most of these ideas were espoused by Blanc, they were originally taken from Humbert de Superville and adapted as needed; so, the emphasis on Henry's influence (via Blanc via Humbert de Superville) in this canvas must be kept in perspective.[11]

Humbert's schema, rather than Henry's, is more immediately identifiable in Seurat's paintings, and Blanc's interpretation of

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[8] See Illustrations 54a and 54b for a comparison.

[9] Herbert, Georges Seurat 1859-1891, p. 340. See Illustration 54.

[10] John Russell, Seurat, London, 1965, p. 240.

[11] Herbert, Georges Seurat 1859-1891, p. 340. In fact, on p. 345 in Note 3, Herbert goes on to state that .."Long ago William I. Homer (Homer 1964, pp. 213 f.) pointed to the risk of attributing to Henry the ideas Seurat had already found in Blanc." This statement helps to explain the great emphasis placed on Blanc's influence in Seurat's theory earlier on in the book.

Humbert, though skewed at times, expands Humbert's original ideas on the expressiveness of colour and for lines. It is only when the movement of lines becomes linked with expressing emotions, that Henry's influence begins to show, especially in the strong "..reliance on a Henryesque schema of upward-flying lines..."[12] This joint incorporation of Humbert and Henry is illustrated in Chahut in the charicatured expressions of the participants; they "..grimace with Humbert de Superville's simplified emotions, and they turn their limbs upward along Henry's lines of movement."[13] Indeed, "grimace" is probably the operative word in that quote; for the joy, if there is any, is anything but natural and is more akin to the forced smiles one gets from small children posed in front of a camera. "Smile for Daddy!" Click!

References to the influence of serial photography on this canvas in particular have been posited in the past.[14] Herbert disputes this as a possibility and I must agree. Photography may have had some influence in as far as capturing specific actions and fitting them into a set composition but I do not see any possibility of using serial photography for Chahut. Serial photography would capture an action and present it from start to finish in intervals of less than two seconds. The dancers in Chahut are all performing the same movement and the scene shows one moment in time of the dance, not one dancer moving her leg through an arc of images created by her leg's movement.

No discussion of Chahut can be complete without addressing the subject matter and any possible message from Seurat. While I would not go so far as to say that this canvas is indicative of

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12 Russell, Op.cit, p. 242.
13 Herbert, Georges Seurat 1859-1891, 1991, p. 344.
14 Russell, Op.cit., p. 242.

Seurat's political inclinations, since it has been proposed in the past that he was on the left, I would, however, agree that he was making a social comment. When we consider his rather risque subject and the bold, close-up presentation of the scenario, the message is drummed in; yet, Seurat's subtle devices in the composition and colour-play offer us a buffer-zone and escape if we need to catch our breath. The viewer feels a voyeur through Chahut since, "in dealing with metropolitan life, Seurat reveals himself as a poet, and as a moralist, and as a critic of society."[15] As Herbert has said, "Caricature is not neutral; it is a form of social attack. The one who wields it is pointing out the foibles of persons and social institutions as subjects of ridicule. Artist and observer share the joke at the expense of those pinned to the surface of imagery."[16]

I believe that Seurat possessed a dry sense of humour and the exquisite ability to present what he saw with a precise and elegant irony, and caricatures offered an outlet for his humour as well as providing a means for transmuting raw, human emotion. Not only could he control what he presented on the canvas but, with his careful presentation of emotive colours and lines, he also aimed to control what was elicited from the viewer.

Even though Seurat has invited us to enjoy a joke to gain his message, again, keeps us at a distance during the very process of trying to understand. The double-bassist in Chahut plays a similar role to the small man with the smeary tie in Parade de Cirque; both figures pull the viewer into the scenario via their actions while simulaneously intervening between contact

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15 Russell, Op.cit, p. 219.
16 Herbert, Georges Seurat 1859-1891, 1991, p. 344.

which could become too close. The specatator has to actively decide what is going on and, more importantly, what it means. Jokes and social commentary may be shared via Seurat's works, but it takes a lot of energy to understand them at times.

Jeune femme se poudrant

It is known now that Jeune femme se poudrant is a painting in which Seurat's mistress was the model and, as such, it is the only painting which revealed some side of this secretive artist's life. And yet, the painting is not a testament to their relationship. Rather, Seurat treated his subject matter as a series of colours, shapes and directional changes and, as such, she was merely another opportunity to try out more of his techniques

The "Étude pour "Jeune femme se poudrant" which Seurat painted during 1889-1890, though a fairly complete version of the final canvas, is definitely a study.[1] The basic components are laid out and the colour relationships are worked out in this piece. The painted border, with its large paint strokes that complement the colours of the objects it immediately abuts, indicates that it was an integral part of the composition, it was not added later.

Although the scene presented in the study is cropped, all of the basic components are there. Directional paint strokes are apparent in her skirt and in the table legs, more so than anywhere else in the study. There are exaggerated tonal effects between the lights and darks from the contours of the figure towards the background although, in this study, this effect is more confined to a broad band rather than flowing and whirling tonal patterns found in the final version.

Jeune femme se poudrant, (1889-90, signed lower right border: "Seurat") is a painting of strong contrasts of shapes and tones and colours; it presents a situation which seems absurd at

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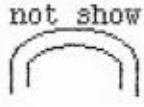
[1] See Illustration 66.

times due to its strong contrasts and yet there is no inclination to laugh.[2] Reading this painting is just as complicated, perhaps moreso, than some of Seurat's other pieces; since we now know of his personal involvement with the model, this makes it difficult for us to remain unbiased.

The border is very wide and painted in, the average width is about one inch. The border's top, which does not show up in reproductions, is curved and looks like this:  . The border slightly mimics the table legs which are the only objects in the pictorial field to extend into the border; though, this is not obvious and one has to really look to discern it. The wall paper pattern does not get carried through into border either, even though it abuts upon more surface area of the border than anything else.

The painting is signed in the lower right hand side in red dots only. An almost solid blue ground lies behind the "signature". The blue areas are lightened by addition of some green but this only occurs when the red pattern of the wallpaper is immediately adjacent. Tiny, tiny strokes like this  are all around and they are directional in places. Herbert makes an interesting observation that, on the extreme outer edge of the border, the paint is incomplete and "edged"; this means that Seurat worked on the border, and, perhaps, finished the canvas, after the frame had been added.[3]

The main figure's features are faint and faded compared to the intensity of her bodice which really "stands out".[4] Again, there is a very directional stitch-like stroke used. The flesh

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[2] See Illustrations 67a and 67b.
[3] Robert Herbert, Georges Seurat: 1859-1891, New York, 1991, p. 336.
[4] See Illustration 68 and compare with Illustration 44.

and skirt areas have slightly larger strokes like these  and the strokes in her skirt are directional. The face is done in such tiny strokes and is so tightly presented, it feels quite overworked. The strokes on the face are so small that, when viewed from any distance beyond 18-24 inches, the face appears flat and gray. The hair colour has an overall impact of being a bluey-purple at a close viewing distance. The colours do not meld into a more natural warm brown or a blue-black as one might expect.

The high contrast of the table legs with their brash highlights requires a much greater viewing distance than that which makes the face "work". There is no comfortable or ideal distance to view this work as a whole: one has to "play the game" to make the parts work individually. This is reminiscent of the need to move back and forth to view Parade de Cirque comfortably.

Scholars in the past have suggested that Seurat painted his portrait in the frame on the wall and then took it out upon due consideration of possible implications.[5] There does appear to be something in that space; a ghostly blue shape shows through the creamy ground, though I wouldn't presume to state why is was put there, who, or what, it might have been or why it was removed. Herbert tries to put to rest the rumour regarding The Face by reporting that an interpretation of the underpaint marks, as seen by x-ray in 1958, were viewed as the bust of man; however, another investigation by x-ray in 1987 emphasizes the complete subjectivity of the earlier judgment so we are no further forward

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[5] Robert Rey, La renaissance du semtiment classique dans la peinture francaise `a la fin du XIXé siécle, Paris, 1931, p. 128-129.

in this search.[6] The vase and table edge, as seen through what became the window, or mirror, are more line-like than spotted which suggests a hurried change of direction here. Whatever happened in this section of the canvas, the uncertainty of Seurat's actions remains obvious.

From a viewing distance of 10-12 feet, the pattern on the wallpaper is easier to see, there are peach shapes on a turquoise background. The skirt now appears a "grungy" light tangerine. The woman's flesh looks rather sickly and has a distinctive gray cast; if is is luminous it most certainly is not healthy looking. At this distance, the difference in the handling of the face and body is not so apparent, and both look off-colour. Her hair, which had appeared too blue up close, now looks browner, though it is the brown from a cheap henna rinse rather than a natural brown. The table loses some of its more vivid characteristics. However, the modulations in the border, the colours of which perfectly though quite subtly complement whatever colour abuts it at any one point, are now quite apparent.

The overall effect is similar to viewing a scene through a piece of lavender-gray tinted piece of window screen or film; a finely networked screen of colour stands between the viewer and the scenario and puts its tone over everything. The darker visual fog which Seurat planned in Parade has reappeared in this painting of an interior lit scene. Perhaps this is the effect he intended; a sort of visual barrier between the viewer and the canvas which makes it difficult to judge colours, contours or details with any certainty.

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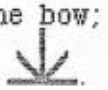
[6] Herbert, Georges Seurat, 1991, p. 336.

There is a problem with the lighting in this work, especially regarding the source of the light. The light should be coming from the upper left hand side yet Seurat has not tried to represent natural lighting effects. On the model's arms, for example, Seurat has darkened the background to offset the highlight on the top of the arm and lightened the background to offset the shadow under the curve of the arm. Although this technique is meant to heighten the effects of the shading, and increase the sensation of a tangible, three-dimensional figure in space, the background becomes wavy and convoluted as a result. The wall, rather than being a flat surface upon which normal shadows would have been cast, becomes a soft and non-descript mound of particles which shift whenever light hits an object and casts a shadow upon it. Thus, Seurat's exaggeration in order to increase the visual impact of the picture also makes the wall and its light patterns difficult to read in the normal manner.

Furthermore, it has been said he gave a good feel for the powder particles whirling in the air, yet his unusual lighting presentation makes everything seem to whirl: not only do the particles whirl within the space of the dressing area, the entire scene whirls into and out of space as the wall undulates with the changing light. The pattern on the wallpaper should visually indicate a solid surface yet the constant change of the tones around the figure so dispells any idea of solidity one begins to wonder how the picture can hang on what appears to be a flimsy piece of gauze.

These visual incongruities concerning light and shade are matched by the disproportionate sizes between the enormous model at her delicate and tiny dressing table. There is a battle

between the dictates of fashion, the desired image, and that all too palpable fleshy figure. How could such a large woman, whose hips and legs remain hidden in swaths of skirt, ever comfortably use the articles we see before her? Surely the stool upon which she sits would match the table in a similar demure and delicate build; could such a petite piece of furniture ever support such a solid figure? The more one looks at this painting, the more the visual incongruities crop up, until we give up trying to read it as a "natural" scene and just enjoy it for its own merits of colour play and swirling movement.

As a final comment on this painting, Russell mentions Seurat's use of the golden section in this canvas and gives credit for the first mention of this to Dorra.[7] Russell does not question this reference nor does he seem to find any need to do so; scholars had come to accept the notion of the golden section and believed Seurat had employed it.[8] What is strange is Russell's continuing discussion when he queries the "butterfly-shaped decoration immediately above the table mirror".[9] After his correct references to Henry's influence on this Seurat piece, he fails to pick up on the shape of the bow; it represents the motif for gaiety as suggested by Henry:  . After failing to make

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[7] John Russell, Seurat, London, 1965, p. 244. The reference to Dorra would have been from H. Dorra and J. Rewald, Seurat: L'oeuvre peint, biographie et catalogue critique, Paris, 1959. If a person tries hard enough to make a theory fit, it is usually possible to do so; this is like working with a set hypothesis and throwing out everything which doesn't fit rather than questioning whether the hypothesis is wrong.

[8] The golden section had been accepted as a tool Seurat used quite regularly in his later canvasses and no one seemed inclined to question this because the association had been so long-standing in academia. It was not until the late 1980s that scholars looked at this issue and Robert Herbert, one of the strongest proponents for Seurat's use of the golden section, publically recanted his position in lieu of new findings. This information was mentioned both in the catalogue published for the New York exhibition as well as in a talk given by Herbert at the Seurat Symposium in December 1991.

[9] Russell, Op.cit., p. 244.

the connection between the shape of the bow and the gaiety motif, Russell then mentions the gaiety motif on the wallpaper and suggests that perhaps Seurat was expressing the joy at his recent parenthood via this shape![10]

From visual incongruities to incongruous interpretations, this canvas holds a firm place in the growing number of major works from Seurat which demanded participation from the viewer. Whether viewers queried the subject matter, objected to the colour treatment or simply wondered about novel treatement of the borders and frames, they would rarely be without any reaction. Even if the world were slowly becoming accustomed to Seurat's works, the latest handling of this figure which, for all the attention to detail, was strangely flat, would have been foreshadowing of yet another factor coming into his technique; that of poster art. The next major work to be looked at, Le Cirque, shows, even moreso, the effects of poster art advertising.

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10 Russell, Op.cit., p. 244.

Cirque

Le Cirque, Seurat's last canvas, was painted in 1890-91.[1] When I first saw this canvas in person at the Paris show, several aspects of the work made deep impressions on me. There is an enormous 7" deep painted blue-coloured frame around blue borders which are painted directly onto the canvas; I had not known this existed since the reproductions (until the 1991 exhibition catalogue) did not show this.[2] The overwhelming blueness of the painted frame emphasizes the blue outlines of the figures and leaves the viewer with a very crisp, light and yellowy first impression of the scene contained within: springtime flowers of clean yellow crocusses surrounded by purply-blue ones with bluebells and forget-me-nots nestling in tender new grass elicit the same fresh promise. There is a delicate feel about the colours on this canvas yet the colours are confidently applied and in no way can be described as being in pastel tones. Although the colours used are not light hues, the sparingly applied dots of the ultramarine blue serve more to tone and shade the canvas rather than to indicate blue objects. The painted border, whose existence was planned from the very beginning, looks much bluer than the blues in the main body of the canvas because they are so intermingled with the yellows and oranges.[3]

The basic flatness of the figures with only their contours being emphasized, helps to create a poster-like effect. The flat, graphic design of the characters in the audience, all with dark outlines, adds to the feeling of a garish, forced and false gaiety which clashes with the seeming lightheartedness and joy of

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1 See Illustration 69.
2 See Illustration 70, a section of final canvas.
3 Robert Herbert, Georges Seurat: 1859-1891, New York, 1991, p. 363.

the performers. The dichotomy between the light, pleasing colours in the happy environment of a circus with the sinister smiles of the participants was quite disconcerting. I was left with the sense that the impact from the canvas was incomplete and, had it been finished, the message would have been stronger and less ambiguous.

Infrared photographs of this canvas reveal an underlying grid and indicate changes in several figures as Seurat worked with the composition; some guidelines in the underpainting reveal that he was quite certain about the placement of some figures while repainting on the top layers in a few figures indicates changes of mind.[4] Although the discussion of the changes revealed in these infrared photos is quite complete, at no time is any indication given that the painting itself is incomplete or considered unfinished. Some of the original blue gridlines are still visible to the naked eye, underneath the horse's belly and across the clown's back, for instance, yet this doesn't seem to raise any concern.[5] To me, the painting seemed unfinished, and that was my initial reaction even before I had noticed the gridlines.

Although the infrared photos revealed much forethought regarding the placement of figures, I sensed that Seurat was trying to go down a checklist and get <u>everything</u> into this one composition. Upraised, curved lines to indicate gaiety? Check, in the equestrienne's stance. Repetitive horizontals to indicate calmness and rhythm? Check, in the distorted and flattened tiers

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[4] Herbert, <u>Georges Seurat</u>, 1991, p. 363.

[5] It should also be noted that Russell, <u>Seurat</u>, London, 1965, states without doubt that "...his reliance on the golden section is never in doubt", p. 259. This statement is probably strengthed by the visual signs of grids which, in reality, were used by Seurat simply to scale up his studies to the final canvas size. Old theories die hard.

of spectators. Simplified facial expression to indicate the essence of the emotion? Check, in the slanty-eyed and coyly smiling audience. I feel that rather than pick-and-choose the most select titbits, Seurat wanted everything included and the resulting visual activity wears out anyone who possesses some knowledge of Seurat's theory.

Le Cirque was the last major canvas Seurat exhibited at the Société des Artistes Indépendants in 1891 and it, along with four Gravelines landscapes, were exhibited for just nine days before he suddenly took ill and died on 29 March 1891.[6] Although this canvas stressed the aspects of composition and the expressive qualities of line and colour as suggested by Henry, critics were quick to attack the painting for its flat figures, simplified characters' faces and lack of detail at the expense of an almost overworked need to express the rhythmic geometry.

Angles of 30 and 60 degrees do occur "at more than one crucial point" in Le Cirque. This is in perfect accordance with Henry's Cercle Chromatique. The colours correspond to those devised and recommended by Henry and the simplified physiognomies are in perfect accordance with the Humbert de Superville's principles to express euphoria.[7] Seurat's use of a few bright colours and simplified forms may have been intended to offset the strict control of the lines and movements and Herbert believes the techniques of Jules Chéret, whose influential connection with Seurat he has proven, helped to counterbalance more severe aspects within the composition.[8]

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[6] Anne Distel, "Cirque 1890-1891" in Herbert, Georges Seurat, 1991, p. 360.
[7] Russell, Op.cit., p. 258 and 255 respectively. Angles of 30 and 60 degrees to the horizontal were said, by Henry, to be dynamogenes and very desirable to indicate positive and gay emotions.
[8] Robert Herbert, "Seurat and Jules Chéret", Art Bulletin 40, 2, (June 1958), p. 156-158.

Why then, did the canvas fail to elicit positive effects, fail to instill any feelings of euphoria, fail to be recognized for its unique contributions and, in short, why did its message fail to come through? I still had the sense that something was missing, that some, perhaps vital, piece, had not been put into the formula.

Perhaps part of this sense of incompleteness was due to the change in Seurat's techniques. A good portion of the canvas priming or base coat of paint is allowed to show through the loosely applied top layer of paint strokes and this, combined with the lack of detail provides a very different feel from his earlier works which were tightly controlled and painted layer upon layer. Although Jeune femme se poudrant showed flattened figures, there was so much detail in the figure's features that this flatness was not immediately apparent. Now, in Le Cirque, not only were the figures flat but they were simply blocked out and lacked identities. If Seurat had used the same face for each of the audienc member's, no one would have been surprised.

This painting seems incomplete not in the sense that Seurat had to "fill-in" more areas because he had not had the time to finish painting his subjects; but, rather, in the sense that he had not finished working on his theory since he kept bringing in new factors to bear upon it. There were still unpolished places in his theory and the formulation was not yet precise enough to allow for a concise statement of his objectives. Although it is impossible to say how Seurat's theory may have progressed, this canvas hints at the new directions in which he was heading.

Rather than manipulating the optical aspects within a given view to elicit purely optical responses, Seurat was beginning to

manipulate colouristic and linear patterns to encourage more cerebral and emotional responses. This canvas, with its great overactivity of both colour and line indicates, to me, the state of play in his unresolved theory: one might say he was "painting out loud" as he continued to work towards clarifying his theory in Le Cirque. His visual games, his questioning of societal roles and playing nature against artifice, his never-ending interest in colour and his desire to examine the expressive qualities of colour and line were all coming together; he just had to determine how much each factor would contribute to the whole theory.

One Hundred Years On:
The Seurat Paris exposition and the Seurat New York exhibition

"Seurat Dashes Off Another Masterpiece" screams the headlines in a Paris Sunday newspaper. "He's Dotty, Our Seurat", continues the article. "Colour Pictures on Page 5". "Please, More Fleas" entitles a critique full of lavish praise for the young painter. "He's young and too spotty for my taste," begins a letter to the Editor. (fictitious 100-year old comments "quoted" to make a point)

Why was there no such uproar and commentary? How, during a comparatively short career, did this single artist manage to capture the complete support of so few while developing good name recognition amongst the masses, only to see what there was of his legacy suffer the ignominy as his country eventually let most of his major works escape its bounds? And why, if he made any impact, controversial or otherwise, did it take one hundred years, almost to the day, for his native land to host a major retrospective of his works?

The Seurat 1859-1891 Exposition at the Galeries Nationales du Grand Palais in Paris was held from 13 April - 13 August 1991. Reviews of the Seurat retrospective in Paris were published soon after the private opening of the show. Although critics and viewers were presented for the first time in France's history with a collection of 100 paintings and over 100 drawings of Seurat's, three of Seurat's major works, La Grande Jatte from Chicago's Art Institute, Une Baignade from London's Tate Gallery and Les Poseuses from the Barnes Collection in Philadelphia, were noticeably absent.[1]

Richard Thomson believes that the lack of those key pieces was one place where the exhibit stumbled before he provides some insight into another reason why it took so long to organize such an exhibit for Seurat, it was not simply a case of neglect on the part of Seurat's fellow countrymen.[2] Seurat, Thomson feels, "has been manipulated in a variety of ways by artists and critics this century" primarily due to a lack of guidance: being reserved and loathe to comment on his work, except in defense of an attack, Seurat seemed more content to let the viewer interpret his works as he saw fit.[3] That, combined with the simple fact that the bulk of the present exposition was on loan from outside of France, served to make it difficult to gather pieces from an artist with subtle and secretive drives.

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[1] La Grande Jatte will never be let outside the confines of its home in Chicago. Une Baignade was glued to a metal support backing sometime during the 1960s which makes it impossible to move without damage to canvas. Les Poseuses, until 1993, was never to be moved (see disoussion in preceeding Les Poseuses section, this chapter). For further information on the factors involved in setting up art exhibits see Sharon Waxman's "A blue period for curators of major art shows", 28 April 1992, Chicago Tribune magazine.

[2] Richard Thomson, "Rinsing out the Eyes", 10 May 1992, Times Literary Supplement.

[3] Thomson, Op.cit., 1992.

The exposition at the Grand Palais showed full-sized black-and-white photographs of the missing Seurats along one wall. Smaller colour studies of the works were nearby but this arrangement may have confused and frustrated viewers. There was a resounding lack of posted information or directional material and only one large board indicated the layout of the exposition: three, large, circular rooms, laid out in a straight line with a "crink" at the end were separated by two lengths of hallway with one final circular gallery on the level below.

The exhibition was in a chronological order and began, on the right-hand-side, with some of Seurat's earliest drawings. These were on various sized sheets of paper and were indicative of the pervasive style influence from his classical training. However, as soon as Seurat broke free from the strict confines of this background, the drawings became more uniform in size--varying by mere millimeters--while his style developed, albeit in an incredibly subtle manner.

The physical aspects in the gallery were disconcerting. Dark muddy-coloured walls, upon which the drawings were hung at eye-level, contrasted starkly with the bright, selective spotlights which shone down out of a high, dark-green, domed ceiling. The change from the overly dark background to the lighted drawings provided too much visual contrast and made it difficult to focus one's eyes, let alone one's thoughts. A break of dialogue on a board or an explanation in-between every two dozen drawings would have been most welcome. It also seemed "backward" to move from right to left against a more natural left to right movement for the chronological display.

The evolution of the style in Seurat's drawings was so subtle, it was almost insidious in its nature. The realization that a change had occurred, somewhere previously in the progression, forced more than one viewer to go back and retrace his steps to try to ascertain where the change had taken place, or if, indeed, it was possible to identify the change as having occurred from one piece to another. The style development in the black-and-white section was ploddingly simple when taken as presented but became intricate and beautiful when a piece was taken out of context for individual analysis.

As Seurat's style became more developed and his hand more sure, it was often possible to discern the watermark on the paper since the force of his hand as he pressed the conté crayon down onto the paper especially highlighted the mark. Les peupliers and Bords de rivi`ere from 1883-84 are prime examples.[4] With time, his technique took on more of a chiaroscuro effect which eventually mimicked today's printer's half-tone separations, although Seurat still used the odd line or scribble for many years when details were being delineated.[5]

Seurat's subjects in these early drawings were people and objects he saw about him; his family, his friends, groups of people at labour and those enjoying leisure activities. There seemed to be no particular themes in the subject matter and the only constant was the loving care he paid to each subject via the obvious skill he possessed for accurately depicting all that he saw. With few exceptions, the most striking aspect of the entire

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[4] Robert Herbert, Georges Seurat: 1859-1891, London, 1991, p. 101 and 102. The watermarks shown are from Michallet in the first instance and from E.D. & Cie in the second.

[5] A detailed discussion of the development of Seurat's drawing style may be found in Chapter Two.

display of drawings was their relatively modest size; most were scarcely larger than a sheet of A4 paper. Throughout the entire display of drawings, there was not one sign; no words or explanations were given near any drawing, even those recognizable favourites were presented without comment. And then, suddenly, the display of drawings came to an abrupt end and ahead lay nothing but a stretch of bare wall.

Just as abruptly as the black and white drawings had ended the colour works suddenly appeared. The walls in this part of the exhibition were lighter and the ceiling seemed less distant, the lighting in the galleries was now more uniform and spotlights were only used in smaller display cabinets. These smaller cabinets were painted with a light turquoise gloss paint, a non-intrusive colour, which housed, on average, three or four croquetons or paintings.

The croquetons were not that dissimilar from Seurat's smaller studies and one had to look closely to see whether the piece on display was painted on canvas or a wooden board. Sometimes, due to the greater viewing distance, the only way to ascertain whether a piece was a croqueton was if there was a slight horizontal crack between the wooden panel slats. Although most of Seurat's croquetons were supposed to have been applied directly to the wood's veneer, some seemed to have extra thick layers of paint on them; this may have been due to a base coat or gesso which was applied to the board first.

The continued lack of information was very frustrating. Granted, the pieces were identified by the title and the medium employed, but the year of creation, the size and the collection from which it was on loan were usually absent. The numbers which

were on each title card did not correspond to the system in either the Dorra and Rewald catalogue or that of César de Hauke's catalogues, but, rather, were indications of the listing order in the catalogue from the museum exhibit. Unless the viewer had a copy of this book, identification of the pieces on view was difficult.

Thomson, too, had appreciated the gradual but steady display of the development of Seurat's drawing technique but was quite concerned when the exposition reached the 1885 paintings of Grandcamp and the 1886 works of Honfleur.[6] Since Seurat had displayed his city works in contrast to his country works to emphasize whatever his present pictorial project had been, the jumble of the Grandcamp and Honfleur works in the present exhibit only served to diffuse the artist's original and intended impact.[7] Seurat's subject matter for his colour works was again taken from what he saw around him whether it was Honfleur, Grandcamp, La Grande Jatte or the Eiffel tower. He continued to depict his favourite subjects and poses but what he had so successfully depicted in black-and-white had now lost some of its vibrancy; the supple lines were quite subdued and restrained to make way for the power of colour.

The enormous sizes of the canvasses, especially after the minute presentations of the drawings, were quite impressive. Not all of the colour works had frames, some of the unframed works were hung directly on the wall whilst others were behind glass in a display cabinet. This would most likely be due to the condition of each individual painting but it made for a rather

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6 Thomson, Op.Cit., 1992.
7 Thomson, Op.Cit., 1992.

disjointed overall effect in the exhibition. This lack of cohesion was further encouraged by the multiplicity of the frames themselves. There were very few simple white frames--what Seurat preferred during one stage of his career--while more ornate, carved wooden frames seemed to proliferate. To further compound matters, most of these "organic" frames had been gilded or painted at some stage and all were dusty and worn. It was possible to see that some of the frames covered part of a painted border but whether this was due to decomposition of the linen, or whether someone had changed the frame out of ignorance, was not clear.

The Seurat 1859-1891 exposition left Paris and headed for the second stage of its showing at the Metropolitan Museum of Art in New York from 24 September 1991 to 12 January 1992. Strangely enough, although one might be inclined to think that the show in Seurat's home base would have been vastly superior to anywhere else in the world, it was not. The New York display, of virtually the same pieces, was better thought out and far more enjoyable to view. Although New York is a city full of wonders, if you know where to find them, it is also city in full contrast to Paris which runs at 33 1/3 while New York zips along at 78. Yet, surprisingly, New York is the city where, on one Sunday afternoon, over 100,000 people poured through the doorways of the Met in order to "git sum culchure"; and, most of them headed towards the Seurat 1859-1891 Exhibition--and with good reason, too.[8]

A major benefit from viewing the collections in both Paris and New York was that certain aspects of Seurat's approach and

[8] The attendance figure was obtained from a very friendly guard at the door.

technical development were easier to see. The disparate effects between the black-and-white drawing section and the colour section, particularly in the Paris show, sometimes made it difficult to attribute the drive and goals to the same artist. However, Seurat's mastery and respect for drawing was a strength every bit as strong as his meticulous approach to painting. By viewing the efforts of his "career" as a whole, one could tease out the threads that ran throughout the whole pattern of his life as well as discern which ones operated individually versus which required another to work.

For example, it became obvious that the directionality of Seurat's brushstrokes continued throughout the ten years of his career. One might suppose that an increased mastery of the pointillist technique would elicit lovely, identical spots of colour and that the need for oblongs, dashes and splodges of colour marching around a border would decrease. However, as soon this seemed to be happening in Seurat's works, the influence of Henry's ideas took hold. What might have earlier been a controlled movement of coloured pellets suddenly became a rush of colour splashes as Seurat pushed upwards in gay abandon or dragged downwards in a depressive melancholy. Ultimately, there were just too many techniques and influences surging through Seurat's brush to analyze each one completely and independently from another.

CHAPTER SIX

Seurat's Vision: More than what meets the eye

A 20th Century Look at 19th Century Colour Theories: Have They Withstood the Test of Time?

Applying the research of 20th century scientific experiments in vision, the psychology of perception and the neurophysiology of perception, to an artist who worked in the mid- to late-nineteenth century with its increasing, though still nascent, visual research, imposes several restrictions. In order to prevent these restrictions from becoming problems which confound the situation even more, the limitations of such applications must be openly acknowledged.

Firstly, any artist who purposely integrated parts of 19th century visual research into his own theory and for his own specific applications was putting himself on very shaky ground. To take the findings of scientific research, which investigates one variable under strictly controlled conditions, and then to apply those selfsame findings into an artistic setting, with fewer factors being controlled rather than more, invites multiple interpretations if not downright disaster. Even if serendipity smiles down and things "work" on a particular canvas, it does not necessarily follow that the new formula will be correct in all cases. Only several replications of each experiment with identical findings would lead the scientist to accept the results but only as they applied to those specific conditions and to no others.

Secondly, when someone with a background lacking in scientific training, decides to pick-and-choose scientific findings to incorporate into his own work, the results must be regarded with some suspicion, even if his initial motives were pure. Not only does such an action serve to contaminate or even nullify the science part as cited above, the entire process can become twisted even further if the findings are then misinterpreted. It is said that "ignorance is no excuse" and ignorance does not justify some of the shortcomings in Seurat's work. Basically, if Seurat wanted to defend his stance, and he did seem to react strongly to any perceived criticism, then he should have been certain that what he was defending was correct.

Beyond the basic query of how directly applicable the relationship was between Seurat's theory and the phenomena being investigated by science, there must be a close examination regarding the science part of the equation and what was really being tested. For example, did scientists investigate successive rather than simultaneous contrast? This may have had little effect on the laboratory findings but would have been of prime importance to the artist. Do scientists investigate different juxtapositions of dots on various coloured grounds versus the even mingling of multi-coloured dots on one surface? Are they even using dots or do they rely solely upon lights? As we have seen, there is the inherent risk of confusing subtractive colour effects with additive effects when the results are applied out of context. Do scientists look at these aspects under different viewing distances or are the findings applicable to one controlled laboratory situation only? And, in the controlled and "ideal" setting of the laboratory, how applicable are these

results to real-life and, therefore, less than ideal conditions? And so on.

This section will attempt to offer some answers to the above questions while it investigates the "correctness" of the visual theories upon which Seurat drew, before it looks at how the progression of science into the 20th century has refined its approach to vision and colour vision in particular. This, of course, does not mean to imply that because we no longer subscribe to a particular theory or approach that it was wrong at the time of its creation. If Seurat used a 19th-century theory, which has since become superceded by another "modern" one, then the first must be judged for its own merits at that time.

Efforts to identify the relationship between the perceived hue and the receptor activity have been addressed ever since the mid 1800s, yet it is only the experiments from the past 50 years which have managed to identify the stages of vision with any certainty. Of all the 19th-century theories and pseudo-theories mentioned so far, it was the main body of work offered by Young-Helmholtz and Hering which best foretold today's stance on visual processing. Although it might have seemed that these theories were too antagonistic for both of them to survive to describe the visual processes, when combined, they become complementary. Basically, at the earlier receptor level of visual perception, the Young-Helmholtz Trichromatic Theory seems perfectly adequate while, at a higher neural level of colour reception, Hering's Opponent Process Theory seems more appropriate.

Support for the Trichromatic Theory is found in numerous studies. There do seem to be three types of photopigments: erythrolabe for red, cyanolabe for blue-violet and chlorolabe for

green; each is maximally sensitive to one primary hue in the visible spectrum although they broadly overlap in responsivity.[1] In 1964 Marks et al. measured the peak spectral absorption of individual cones (red 570nm, green 535nm, and blue 445nm) which supports the Young-Helmholtz concept of three types of colour receptors.[2] These studies suggest that once light has struck the retina, the reaction in each receptor is a function of the energy of the stimulus and the spectral sensitivity of the receptors.[3]

Colorimetry work and certain types of anomolous colour vision, especially dichromatic vision, also support the Trichromatic theory.[4] Colorimetry is the systematic measurement of colour by using additive colour mixing which entails combining spots of light to create spectral hues; the primaries for colorimetry are red, green and blue.

Dichromatic vision, or partial colour blindness, is that which works with only two colours because one of the three receptors is missing. There are different forms of partial colour blindness. Protanopes have no red receptors, they cannot discriminate yellow and perceive luminosities which are greatly reduced. Deuteranopes have no green receptors, they cannot discriminate yellow but perceive normal luminosity. Tritanopes have no blue receptors and are unable to discriminate greens. In the areas where the visual confusion occurs, the sufferer perceives only gray tones, rather than the expected colour. "In

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[1] B.R. Wooten and J.S. Werner, "Opponent Chromatic Mechanisms Predict Hue Naming" in Frontiers in Visual Science, Vol. 8, New York, 1978, p. 165.

[2] W.B. Marks, W.H. Dobelle and E.F. MacNichol." Visual pigments of single primate cones," Science, 143, 1964, p. 1481.

[3] W. Wright, The Measurement of Colour, 4th. ed., London, 1969, p. 45.

[4] Individuals who experience abnormal colour vision are studied with great interest because it is easier to study the effects from one known defect rather than trying to analyze a complete and normally functioning system before determining how each component influences the others.

other words, according to Young's hypothesis, the nature of dichromatic vision is such as might be expected in the case if one of the three fundamental receptors characteristic of normal colour vision were lacking or atrophied."[5]

Strangely enough, while it might seem that a red-green colour blindness (protanopes and deuteranopes) would suggest support for Hering's theory as well, only the protanopes experience the loss of brightness in the long-wavelength region of the spectrum.[6] The implications of this difference are that even though both protanopes and deuteranopes lose their abilities to discriminate between hues, the extra brightness loss experienced by the protanopes is an unexpected consequence for which Hering's theory cannot account.

Nonetheless, there are cases of colour blindness which have been taken as support for Hering's theory. One particular individual was colour blind in only one eye; reports were made with the normal eye about what was seen with the defective one, only yellow and blue were perceived while red and green were indistinguishable.[7] This case supports Hering who would expect yellow to remain unaffected in a system suffering loss of red and green while it simultaneously refutes Helmholtz who believed yellow to have been formed from a combination of both the red and green receptive units.

The Young-Helmholtz Theory cannot explain colour contrast yet Hering's theory can explain a version of this involving coloured shadows. Due to lateral inhibition, shadows in red

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[5] J.P.C. Southall, Introduction to physiological optics, New York, Dover Pubs. 1937, p. 347.
[6] Hering, Outlines of a theory of light sense, 1878 (L.M. Hurvich and D. Jameson, trans.). Cambridge, MA: Harvard University Press, 1964, p. xx.
[7] Hering, Op.cit., p. xx.

light will appear green, those in a green light will appear magenta, and those in a blue light will appear yellowish. This has been supported by experiments which have shown that receptors are tuned to various levels of illumination and coloured shadows are a product.[8]

Research with afterimages provides support for both the Trichromatic and Opponent-Process theories. Responses in photoreceptors continue well after the initial stimulation until fatigue occurs and the opposite receptor reacts; this is why staring at a drawing of a green, purple and orange tri-colour flag for a minute will produce the opposite, and expected red, yellowy-white and blue flag when the fixation is broken.[9] Some afterimage effects have been induced so successfully that they can last for weeks; although, these afterimages also affect feature detectors for movement so that the image, in its opposite colours, also appears turned around.[10]

One of the facets of Hering's theory is that brightness is not solely due to the black/white aspect but also due to the red/green and yellow/blue aspects as well. In the 120 years since Hering's original postulation, there has been considerable evidence that brightness is due, in part, to the chromatic systems. According to a 1966 study, Wasserman states: "...brightness enhancement is a manifestation of wavelength-dependent transient retinal activity in the two-chromatic systems of the opponent-colors theory" and furthermore that "this

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[8] F.S. Werblin and Dowling, "Organization of the retina of the mudpuppy, Necturus Maculosus. II. Intracellular recording", Journal of Neurophysiology, 32, 339, 1969.

[9] See G. Murch, Visual and auditory perception, USA, 1973, p. 59 for an explanation of Fechner's subjective colours.

[10] W.R. Webster, B. Crassini & K. Willenberg, "Simultaneous color contrast from McCullough effects is spatially contingent", Perception and Psychophysics, 1987, 41, 402-408.

transient activity occurs at those wavelengths which are perceived as unique hues."[11] Unique hues may be defined as those hues that are determined by each subject, under numerous experimental trials in controlled conditions, to be the epitome of blue, green or yellow. Wasserman concluded that brightness is produced in those three distinct spectral locations and indeed that "...brightness enhancement depends critically on wavelength."[12]

When considering spectral hues and how they are dependent upon the intensity of illumination, research done by Tschermak has identified three hues which are labelled as "pure": Pure yellow (570nm), Pure green (500nm) and Pure blue (470nm).[13] This means that, with the sole exception of the above listed colours, changing the intensity of illumination changes the remaining spectral hues. The ultimate effect is a "tendency of all the spectral colours to become either more yellowish (in case of the long waves) or more bluish (in case of the short waves), depending on whether they are situated in the spectrum on one side of pure yellow or on the other side."[14]

These two experiments show further support for Hering since the opponency channels determine hue in a simple, direct manner. The above "pure" or "unique" hues are the points where the system is in equilibrium; pure yellow, for example, represents an equal balance of red and green while the blue/yellow channel is highly responsive in the yellow direction.[15] Further experimentation in

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11 G.S. Wasserman, "Brightness enhancement and opponent-colors theory", In Vision Research: Vol. 6, London, 1966, 689-699.
12 Wasserman, Op.cit., p. 698.
13 Tschermak, Spectral hues variation with intensity,in Southall, Op.cit., p. 342.
14 Tschermak in Southall, Op.cit., p. 342.
15 Wooten and Werner, Op.cit., p. 169.

1978 was done under the supposition that the strength of an opponent channel is reflected by the relative radiance of an added light that brings that channel to equilibrium; monochromatic stimuli in blue, green and yellow were presented at an equal luminance and at the level which corresponded to each observer's predetermined unique hue.[16] Using equal levels of luminance assured that the radiance of the cancelling lights reflected the strength of the opponent channels for the stimuli. Calculations were made for the findings, the details of which need not be entered into here, and, at the luminance level tested, the opponent chromatic cancellation process correctly predicted hue naming: "...the code for hue naming is provided by the opponent mechanisms which we measured psychophysically and which others have identified in the receptive fields of single cells at several levels in the primate visual system."[17]

The implications of the above experiment are broad when applied to Seurat's work. A literal application of these results means that the use of blue, green, and yellow in spans from as little as 2 nm to 9 nm in length--which is still extremely small--will increase the resulting brightness. Unfortunately for the artist, only those particular blues, greens, and yellows will enhance brightness. The probability of Seurat having used those particular hues once or twice is not large but to hope that he had used them consistently seems an impossible feat and, even then, the lighting viewing conditions would have had to have been ideal.

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16 Wooten and Werner, Op.cit., p. 171.

17 Wooten and Werner, Op.cit., p. 173. These researchers warned that problems can occur when terms are used to refer to both the receptor and perceptual or neural levels and that the whole issue can become a "red-Hering". Painful but true.

However, for the sake of our argument, let us assume that Seurat did indeed happen to use the ideal, or unique, colours as identified above. Since he tended to use opposites rather than analogous hues even the application of the unique green could only increase the relative brightness by a notch when placed next to a "regular 'ol red" hue. Only in places where a unique green abutted onto a unique yellow would the brightness be noticeably increased.

Although Hering's notion of the black-and-white factor was intended to represent the brightness value of colour, fundamental toned colours have a natural variation in brightness, a sort of inherent B/W element, and adding another black-and-white component would seem to be redundant. Furthermore, while one can move from black to white with slight gradations in tone, one cannot move from red to green similarly.

One of the longest standing problems with Hering's theory concerns the colours of white and yellow; they cannot be accounted for under its auspices. Yellow is yellow, not a reddishy-greeny-yellow, it is yellow. If both the red and green are simultaneously excited, how does this theory account for the fact that a totally independent colour, i.e., yellow, is the result? The only possible explanation was offered in 1934 by Hecht.[18] In an experiment where he stimulated the fovea of one eye with red and the fovea of the other eye with green, the resulting binocular fusion of the two colours resulted in the mental sensation of yellow.

Obviously, there will always be some aspects which fail to translate well from the idea of controlled scientific retinal

[18] Hecht, "Vision", A handbook of general experimental psychology, 1934, p. 791-2.

fusion to the idea of optical mixture with which Seurat was experimenting. A number of factors could be at play. The size of the dots used, the regularity of their application, the "pureness" of the pigments and the actual physical composition and limitations of the human eye all serve to affect the outcome in a pointillist's approach to optical fusion. Yet, it is possible to put forth an argument that Seurat's technique of juxtaposing contrasting hues, such as placing a red dot next to a green dot, represents a variation of Talbot's Law with its inherent Critical Fusion Frequency (CFF).

Talbot's Law is concerned with the difference in perceived brightness of a light stimulus when the original intermittent presentation of that stimulus is increased enough to make the light appear continuous; instead of the "brighter" light when the stimulus flickers, it appears less bright after fusion into a "continuous" light. The rate at which the flicker disappears and the interrupted light appears steady is known as the Critical Fusion Frequency (CFF).[19]

The question to be addressed here is how literally can one apply this idea of retinal fusion into the realm of art as represented by the work of Seurat? Instead of the flashing light stimulus in Talbot's Law, one could substitute different chromatic wavelengths which, if the wavelengths were specifically chosen, would create a flashing within the visual system. This would mean that at the CFF, or where the colours fuse, the brightness will be decreased; conversely, incomplete fusion, or a flicker between the colours will maintain a greater brightness.

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19 Schiffman, Sensation and perception: An integrated approach, New York, 1976, p.191.

In 1973, the CFF was investigated as a function of the varying wavelengths and stimulus intensities.[20]

The results indicated that once the absolute threshold was surpassed, the scotopic function became independent of wavelength while the photopic function became less intense with decreasing wavelengths.[21] Since the photopic CFF function is independent of wavelength at the absolute threshold it appears that in brighter situations or with a more intense stimulus, only the longer wavelengths will achieve fusion.[22] Thus, applying these results directly to Seurat's work, means that the red end of the spectrum will tend towards fusion more readily than the blue end. Therefore, colours in the longer wavelength region of the spectrum will fuse and reduce the overall brightness while keeping colours just below the point of fusion will maintain the greater degree of brightness.

When this research is combined with the work on unique or pure colours, it would seem highly unlikely that the CFF would have been reached since the photopic function has to be extremely intense for fusion to occur. However, as suggested by the previous experiment, CFF really is not desirable for brightness enhancement. Maintaining the visual flicker between colours and using the specific unique hues would have provided Seurat with the greatest chances of increasing the brightness of his works. Yet, the very fact that Seurat was working with pigments, rather

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20 Wilson, A.J., and Kohlfield, D.L. "Critical fusion frequency as a function of a stimulus intensity and wavelength composition", Perception and Psychophysics, 1973, 13, 1-4.

21 Wilson and Kohlfeld, Op.cit., p. 3. The absolute threshold is the point of transition between stimulii which do not elicit a respone and those which do. The absolute threshold of the visual system may thus be defined as the difference between photopic vision and scotopic vision, each with its own luminosity function.

22 Wilson and Kohlfeld, Op.cit., p. 4.

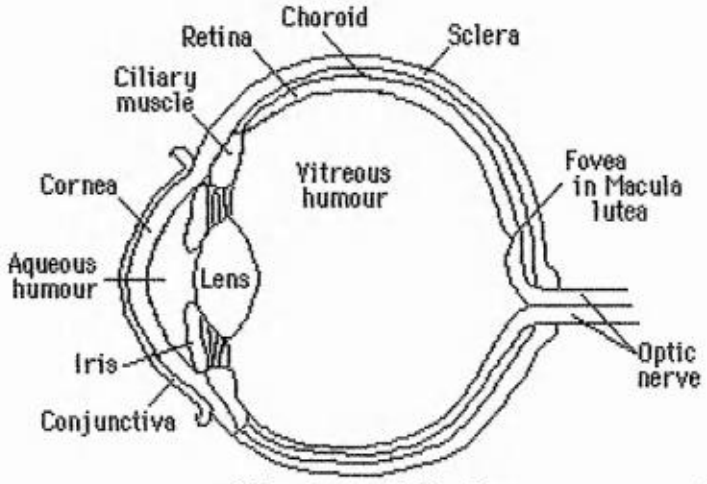
than lights, limited his potential to succeed. In reality, Seurat could not ever have achieved what he desired by duplicating with pigments had been perceived with lights, he could only suggest.

Research on colour vision had to remain theoretical until it was determined how each response preserved its identity as it travelled to the brain. It was not until the middle of the 1980s that exciting findings began to be published from all around the world and the final years of that decade brought research regarding the theories of colour vision further than ever. The next section will offer a brief discussion on the anatomy of the eye before the visual signal is examined (in depth) as it passes from the photoreceptors through the eye and on towards the brain. The latest research on the colour pathways in the visual cortex suggest some striking consequences for Seurat's approach to painting.

Anatomy of the Human Eye

In order to appreciate the eye's optical functions, it is first necessary to obtain a basic understanding of the anatomy of the eye and learn how the key parts contribute to the beginning stages of the visual process. The eye is a "complex sensory organ designed to perform both optical functions for image formation and nervous functions for photic transduction, image analysis, and image transmission to the brain".[1] Learning how these components work, both singly and in the process as a whole, will enable some of Seurat's intentions to be judged regarding their physical and neurological possibilities.

Human Eye Structure: In a normal and healthy human eye light first passes through the cornea whose high density and curved surface refracts the light rays inward towards the back of the eye.



Structure of the Eye [2]

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[1] Kapit, et.al., The physiology coloring book, London: Harper Collins Publishers, 1987, p. 92.

[2] Originally from Kapit, et.al., Op.cit., p. 93 with simplifications and changes due entirely to this artist's/author's graphic skills on the computer.

The light then passes through the vitreous humour which is a viscous fluid in the anterior chamber between the lens and the cornea.[3] The lens itself is crystalline and acts like a biconvex glass lens; parallel rays of light from more than 20 feet away are refracted inward to converge upon a focal point behind the lens and along the optical axis.[4] When the light leaves the lens, it passes through the vitreous humour, which is a jelly-like substance in the posterior chamber of the eye, before it hits the retina. The point at which the image is cast on the retina is called the focal point.

The eye accommodates to focus sharply on objects near and far away through the lens's ability to change its curvature. For objects up close and with bright lighting conditions, the iris sphincter muscles contract so the pupil is constricted which increases the depth of field; or, as the ciliary muscles contract, the lens gets rounder. During close-up vision, both eyes converge and "the pupillary constriction occurring in this is also called the convergence response."[5] For objects far away, the iris dilator muscles relax and open up the pupil which increases the focal distance; the ciliary muscles relax and the lens is flattened. The following simple illustration shows these two processes:

Close-up viewing
Pupil constricted

Far-away viewing
Pupil opened [6]

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[3] Kapit, et.al., Op.cit., p. 92.
[4] Kapit, et.al., Op.cit., p. 92.
[5] Kapit, et.al., Op.cit., 92.
[6] Originally from Kapit, et.al. Op.cit., p. 93.

Light is a form of radiant energy that is radiated in quanta, in the form of photons which travel in waves, to which the eye is sensitive. The lengths of the waves vary from the longest visible wavelength, which appears as red, to the shortest, which appears as blue; measurable energies also correspond to this range from the least energetic (red) to the most energetic (blue). Vision is mediated by two types of photoreceptor cells in the retina: cones which are sensitive to high radiance spectra and rods which are primarily sensitive to low radiance spectra.

In the past 25 years or so, techniques have advanced so much that it is now possible to measure the effects of one photon of light upon the receptors in order to assess the triggered signal as it moves through to the brain.[7] The operation of the photochemical process in the visual system from the initial transduction of light energy, through the photoreceptor cells (PR-cells) and how their potential is then transmitted to the neural cells can be broken down into specific stages. However, it is important to have some knowledge of the physical composition of these photoreceptor cells and their identifying characteristics-- which are the only cells sensitive to light-- before looking at the remaining types of cells in the retina.

Retinal cells, their structure and their functions:

The retina, the eye's neural part, covers most of the eye's inner surface with the blind spot and the fovea being the only other areas on this inner surface. The central area of the

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7 See J.L. Schapf and D.A. Baylor "How photoreceptors respond to light", Scientific American, April 1987, p. 32-39 for a review of the research.

retina, which is is line with the visual axis, is called the macula lutea, or yellow spot.[8] The fovea is found in a depression in the centre of the macula, measures approximately 1.5mm in diameter, and is separated from the edge of the optic disc by a distance of about 2mm.[9]

As stated, the photoreceptor cells (PR-cells) are the first to be activated in the visual process and these are comprised of the cones, found mostly in the fovea, and rods, found around the cones, outside of the fovea. Basically, the cones are responsible for the sensation of colour (photopic vision) under strong illumination while the rods function with greater sensitivity under lower illumination (scotopic vision).

Approximately 7 million cones are found in the human retina with 100,000 cones in the fovea itself; 35,000 cones (and no rods) are in the centre of the fovea called the foveola.[10] There are three types of cones which have become specialized to absorb portions of light over a limited range of the spectral wavelengths with a maximum absorption at a particular region of the spectrum. These three cones, with their special types of visual pigment have been identified as erytholabe (red) at 570nm, chorolabe (green) at 535nm, and cyanolabe (blue) at 445nm.[11] The average of these measurements is 550nm, a sort of yellow-green colour, which is where the colour system is maximally sensitive.

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[8] The reason for the simpler name is due the presence of a yellow pigment whose purpose is to filter out the blue parts of the spectrum which would be too strong for the eye to endure. Barr and Kiernan, Op.cit., p. 297.

[9] Barr and Kiernan, Op.cit., p. 298

[10] Barr and Kiernan, Op.cit., p. 302.

[11] Hershberger, lectures, 1982. Despite intensive research, the photosensitive compounds have not been identified by their molecular composition, see Barr and Kiernan, Op.cit., p. 299.

There are 120 million rods in the periphery of the human retina. Thus, the ratio between rods and cones in the periphery of the retina is 100:1; this allows for high sensitivity in low illumination. This explains why when we look slightly away from something under low illumination, such as a star in the sky at night, we are able to see it better than if we looked directly at it. This indirect viewing "throws" the image to the periphery of the retina which enables better viewing since the rods function better under lower levels of illumination.

The scotopic system depends upon the visual pigment in the rods called rhodopsin (visual purple) which is maximally sensitive at 505nm.[12] In simple terms, rhodopsin is an unstable, light absorbing chemical which is bleached out by strong light but which regenerates in darkness. This is why when a person steps into a movie theatre from a brightly lit lobby, while his photopic system is dominant over the scotopic, he is momentarily blinded and unable to see things clearly. After a few minutes, shadowy outlines are perceived until objects become much clearer as the rhodopsin becomes fully functioning again and the scotopic system takes over from photopic.[13] Thus, the scotopic system is better suited to dark adaptation while the photopic system functions better in stronger light.

A quick summation of the basic processes and descriptive aspects of each of the photopic and scotopic systems follows:

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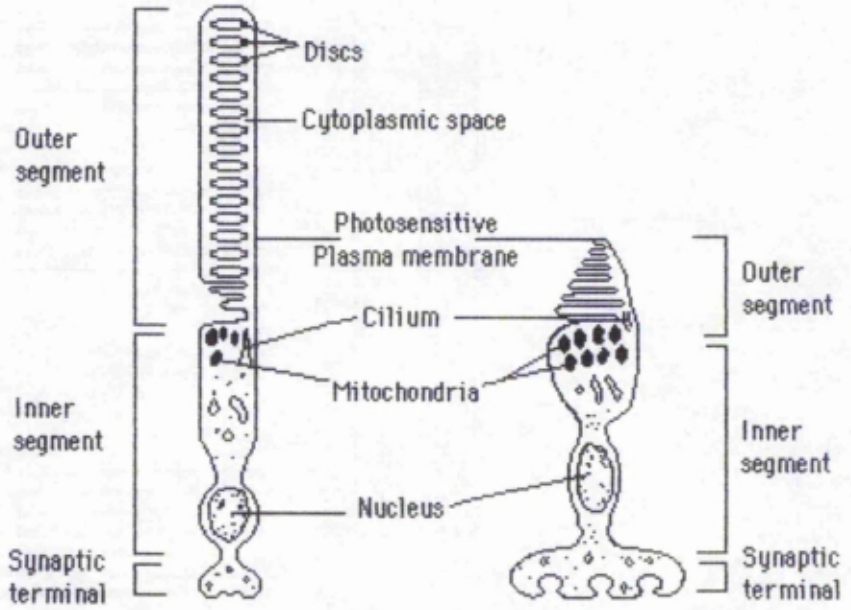
[12] Hershberger, Op.cit., 1982.

[13] During the time when the subject moves from a brightly lit environment to a dark one, the eyes undergo a process called "dark adaptation". In approximately 30 minutes, the visual system will increase its dark retinal sensitivity about 100,000 times. See p. 93 in Kapit, et.al., Op.cit. for a more detailed explanation of this process.

Photopic/Cones	Receptor	Scotopic/Rods
7 million		120 million
Centre concentration	**Retinal location**	Periphery, none in fovea
Discriminative	**Neural processing**	Summative
555nm	**Peak Wavelength**	505nm
$1-10^{7}$mL	**Luminance level**	10^{-6}-1mL (night)
Normally trichromatic	**Vision**	Achromatic
7 minutes	**Dark adaptation**	30-60 minutes
High acuity	**Spatial resolution**	Low acuity
Fast reacting	**Temporal resolution**	Slower

Although the PR-cells have specific purposes, with each system being specialized to function optimally under certain conditions, the actual physical structural composition of the rods and cones is surprisingly similar. The general structure of the each of the two photoreceptor cells is shown below.



The two types of retinal photoreceptors, the rods and the cones.
(Modified from Kandel and Schwartz, 1985, after O'Brien, 1982.)
The synaptic terminal relays signals to the BP- and H-cells. The outer segment, furthest from the lens, absorbs light and generates electrical signals. 14

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14 Brown, A.G., Op.cit., p. 147. For further reading, the research referred to: Kandel, E.R. and Schwartz, J.H. Principles of neural science, 2nd edn, Elsevier, New York, 1985 after O'Brien, D. F., "The chemistry of vision", Science 218: 961-966.

Both the rods and the cones have three sections: the outer segment, the inner segment and the synaptic terminal. The outer segment, which is the part of the cell which is specialized to be photosensitive, is where the largest structural differences between the rods and the cones occurs. In the outer segment, there is an "elaborate set of membranous specializations (discs) stacked on top of one another, and the photopigments that catch the photons are contained within the membranes of the discs. In rods the outer segment is longer than in cones and also the membranous discs are pinched off from the outer cell membrane, whereas in cones the discs remain connected with the surface membrane."[15] Inside the inner segment resides the nucleus of the each cell in which the final section of the synaptic terminal "makes presynaptic contact with bipolar cells and (in rods) with horizontal cells and is itself post-synaptic to horizontal cells.[16].

In addition to the PR-cells, there are four other types of neural cells: horizontal (H), bipolar (BP), amacrine (A), and ganglion (G).[17] Initially, light bypasses the neural cell layers as they move aside to reach the photoreceptor cells of cones and rods and it is only after the light has been processed through the PR-cells that these neural cell layers become activated.

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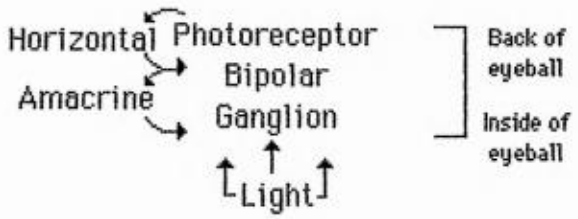
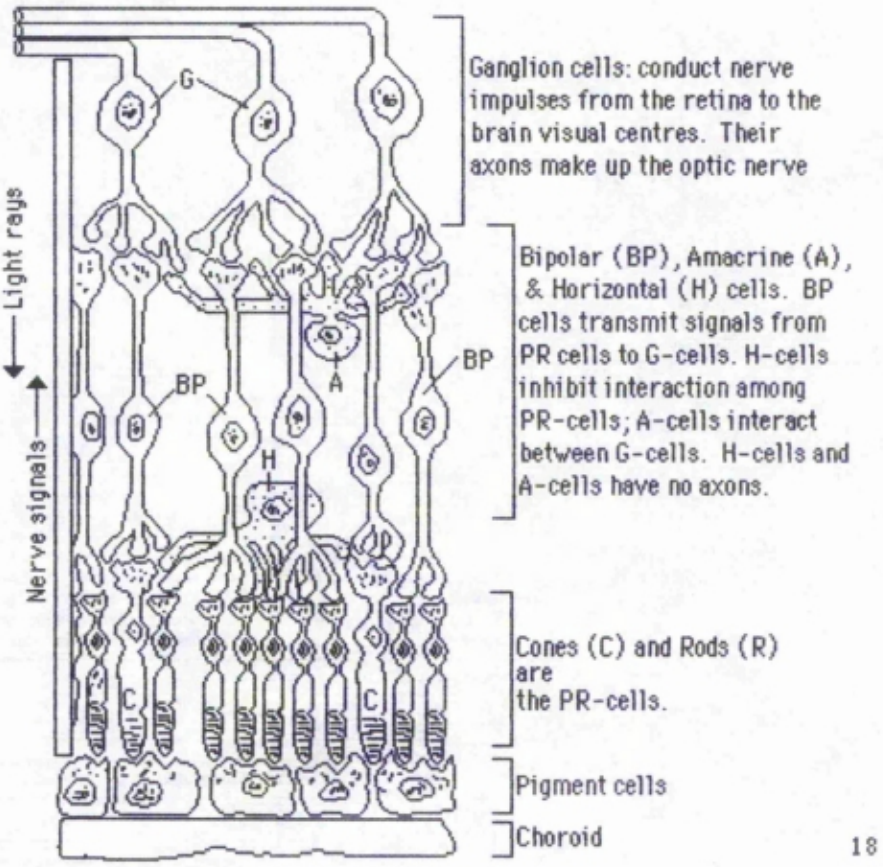
[15] Brown, A.G., Op.cit., p. 147.
[16] Brown, A.G., Op.cit., p. 147.
[17] Brown, A.G. Nerve Cells and Nervous Systems: An Introduction to Neuroscience, London, 1991, p. 146.

5 Layers of Retinal Cells:



BP- and G-cells are pushed aside to let light strike the photoreceptor cells.
Cones to G-cells are nearly 1:1 Rods to G-cells are 100:1

Since receptor cells have no neural impulses, the four remaining neural cells in the retina (H-, BP-, A- and G-cells) must carry on the message by turning the light impulse into manageable neural signals. Thus, what goes toward the PR-cells as light, comes out as nerve signals (in the form of electrical charges) for the remaining neural cells to process. The retina's neural structure is depicted below:



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Thus, the three main cell layers in the retina are:

1) Photoreceptor cells (PR-cells), the rods and cones, are in the outermost layer;

2) Bipolar cells (BP-cells) are in the middle layer; and,

3) Ganglion cells (G-cells) are found in the innermost layer.[19]

BP-cells are "the true neurons interposed between photoreceptor cells and ganglion cells. One bipolar cell is contacted by numerous rods (ranging from 10 near the macula to 100 at the periphery)".[20] The BP-cell connection with cones is quite different, however, with little convergence of the cones in

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18 Originally from Kapit, et., al., Op.cit., p.94.

19 Kapit, et.al., Op.cit., p. 93.

20 Barr and Kiernan, Op.cit., p. 302.

the periphery and absolutely none at the fovea where "each cone fiber synapses with several bipolar cells.[21] The "responses of the photoreceptors are transmitted by bipolar cells to ganglion cells within the retina, and axons of ganglion cells" before the signals continue on to their destinations in the brain.[22]

Nestled in-between the three layers of retinal cells are found two other cell types, the horizontal cells (H) and amacrine cells (A); these are "found adjacent to the PR-cell and G-cell layers, respectively".[23] Amacrine cells have no axons and are found in the inner part of the region which is also occupied by the bipolar cells. They interact between the G-cells by modulating the activity of the neighbouring G-cells with the BP-cells.[24] Horizontal cells have no axons, either, and are found in the outer part of the region occupied by the bipolar cell bodies. They "modulate the activity of neighboring PR-cells and influences the interaction of PR-cells with BP-cells."[25]

This final part of the retinal link is maintained by the ganglion cells (G-cells). It has been mentioned how BP-cells and G-cells are pushed aside initially to let light strike the cones without interference. Yet, when the returning signal moves through the foveal area of the retina--where there is almost a 1:1 ratio between the cones and G-cells--the excitation and inhibition of G-cells is dependent upon the properties of the PR-

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21 Barr and Kiernan, Op.cit., p. 302.

22 Barr and Kiernan, Op.cit., p. 296.

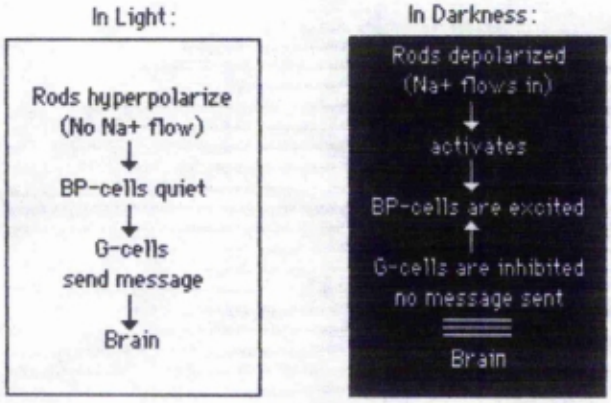
23 Kapit, et.al., Op.cit., p. 93.

24 Kapit, et.al., Op.cit., p. 93

25 Kapit, et.al., Op.cit., p. 93. H-cells are involved in the inhibitory interation among PR-cells by modulating the activity of th PR-cells, and vice versa; and also influence the interaction between the PR-cells and the BP-cells. The activity between the PR-cells and the H-cells causes lateral inhibition of adjacent areas on the surface. To measure the level of sensitivity of the organism's retina to the levels of illumination, lateral inhibition of the ganglion cells, the last in the series, must be achieved.

cells and BP-cells; this is atypical of most neurons elsewhere in the body.[26]

G-cells maintain a sustained, spontaneous rate of firing and are modulated by changes in illumination or stimulation. For example, a single flash of light will hyperpolarize both the PR-cells and BP-cells but depolarizes the G-cells.[27]



Rods are connected in groups to a G-cells while cones are connected on a one-to-one basis to ganglion cells. Ganglion cells are large neurons whose function is the conducting of the PR-cells' impulses from the retina to the brain's visual centres; this is done via the axons of the G-cells which make up the optic nerve. Thus, messages regarding the state of the photoreceptor cells are conducted via the optic nerve to the brain.

It is known that "the optic nerve corresponds histologically to the white matter of the brain rather than to a peripheral nerve. The retina and the optic nerve are, therefore, outgrowths of the brain that are specialized for sensitivity to light, for

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26 Barr and Kiernan, Op.cit., p. 302.

27 See Appendix J for an explanation of the hyperpolarization process. "Rods are the only sensory receptors that are *not* depolarized by sensory stimulation; instead, they are *hyperpolarized*." Kapit, et.al., Op.cit., p. 93.

some modification of sensory data, and for transmission of the resulting information to the thalamus and cerebral cortex."[26]

Although the above brief descriptions may seem superfluous to a discussion of Seurat's colour theory, having a basic knowledge of the anatomy of the eye and how light and, most importantly for Seurat, colour, is perceived is absolutely essential when determining the physical and neurological extents to which his ideas would have been possible. And it is only after detemining these extents that one can accurately judge whether or not his theory and his painterly expressions of the same were successful.

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[26] Barr and Kiernan, The Human Nervous System: An anatomical viewpoint, 5th ed., USA, 1988, p. 297.

Higher Levels of Visual Processing:

From the eye to the brain

The visual signal proceeds through the layers of the retina, where it is converted from a light impulse to a neural impulse, on towards the brain. There are numerous complex interconnections between the PR-cells of the retina and the cortical cells of the visual area of the brain. These are measured by recording the electrical responses of the single nerve cells in experiments involving light patterns (varying in orientation, size and pattern) which have been projected over specific areas of the retina. If the presentation of the stimuli is of sufficient intensity or quality to produce the firing of a sensory cell, the cell's receptive field--that part of the visual field which excites or inhibits the cell--has been identified.

Cells can only analyze what is in their receptive fields. The most common type of receptive field is the centre surround where what excites the centre inhibits the surround and vice versa. G-cells have extended retinal fields, that is, several areas of the retina, if affected by a stimulus, will affect the ganglion. Experimentation has determined that the receptive fields of the ganglion cells have circular, antagonistic components which are concentrically arranged; this is diagrammed below: [1]

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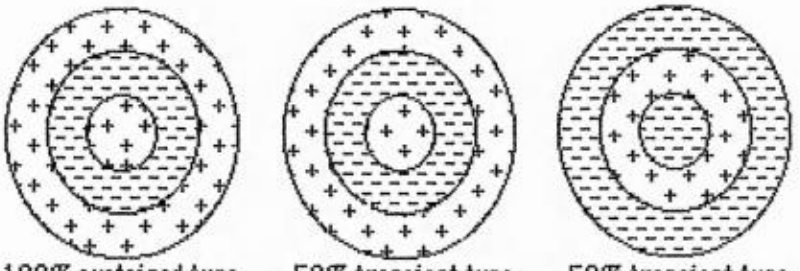
[1] Hershberger, Op.cit., 1982. For a further discussion of the receptive fields of cells and the type of stimuli to which the cells are responsive, see Appendix K.



Ganglion cells' receptive fields

Beyond the stage of G-cells, there are simple and complex cortical cells. Hubel and Weisel, two well-respected and recognized researchers in the field of vision, have measured the size of some cortical neurons' receptive fields at less than 1 degree of visual arc while cortical neurons on the periphery have a larger receptive field of 32 degrees of visual arc.[2] The main distinctions between simple and complex cortical cells is that simple cells must be stimulated and they receive input from sustained ganglion cells only. Complex cells, however, experience spontaneous activity and get their input from sustained as well as transient G-cells.

The reports from the ganglion cells are compiled from each eye and the information passes out of the eye via the optic nerve. The diagram below illustrates these visual pathways:

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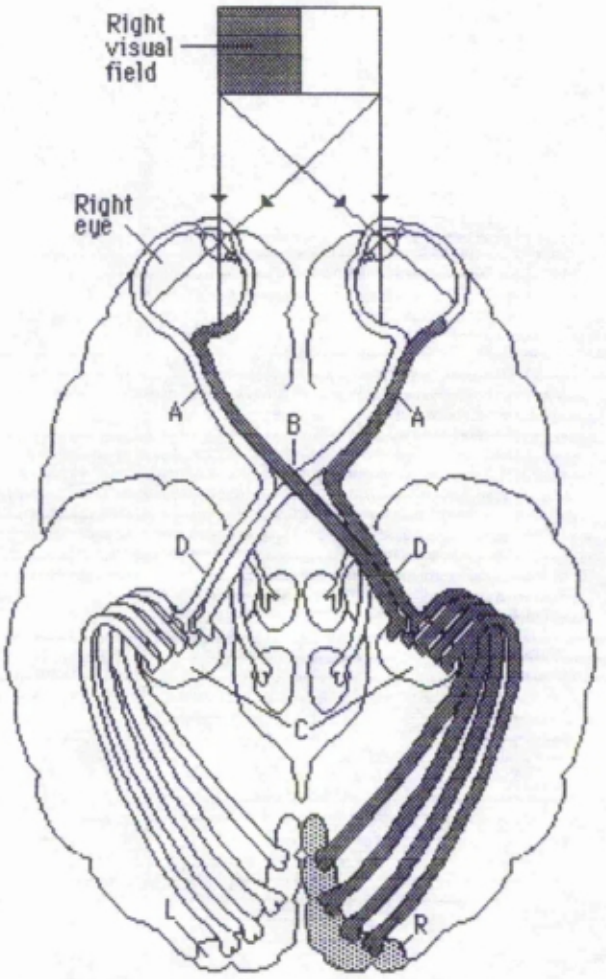
[2] Hubel,D.H. and Weisel, T.N. "Receptive fields, binocular interaction and functional architecture in the cat's visual cortex", Journal of Physiology, 160: 106-154, 1962. The visual angle refers to the angle formed on the retina while the acuity value is a joint function of the target size and the distance of the target from the viewer. This is measured in seconds of arc, with 60 seconds in each minute and 60 minutes in each degree of angle.



Brain as viewed from below
A=Optic nerve; B=Optic chiasm; C=Lateral Geniculate Nucleus (LGN); D=Optic Tract; in the Primary Visual Cortex
L=left eye and R=right eye. 3

The optic nerve becomes the optic tract at the point called the optic chiasm; the fibres from the nasal side of each eye cross over while the fibres from the temporal side remain on the original sides. Although the fibres from the optic tract terminate in a few areas of the brain, it is the area called the lateral geniculate nucleus (LGN) which has the greatest importance. The LGN is in the thalamus where the first synapse

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3 Originally from Kapit, et.al., Op.cit., p. 95.

is made and where much of the integration of the visual signals is located.[4]

The greater concentration of ganglion cells emerging from the fovea, with their function in respect of visual acuity, spatial perception and colour vision, requires greater cortical space than that needed by signals emerging from the periphery of the retina.[5] Thus, the principle afferent inputs, from the retinal ganglion cells through the optic nerve to the optic tract, proceed to the LGN before progressing on to the major projection sites in the visual cortex of the occipital lobe.[6]

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4 Kapit, et.al., Op.cit., p. 94.
5 Kapit, et.al., Op.cit., p. 94.
6 Brown, Op.cit., p. 180.

Primary Visual Cortex Onwards: Exciting new discoveries

As a pre-eminent researcher states: "Understanding colour vision amounts to understanding how the nervous system transforms the information contained in the electromagnetic radiation--which is itself colourless--into the colours which enrich immeasurably our visual environment."[1] The study of colour vision has taken a different emphasis in the past few years with a stress on the cortical associations having greater importance than those associations which are retina-based. This new stress in the research has produced some interesting results and has shown that vision and, more particularly, colour vision, is more complicated and far more elaborate than previously thought. A diagram of the visual map, from the lateral geniculate nucleus (LGN) to the cortex is shown below:

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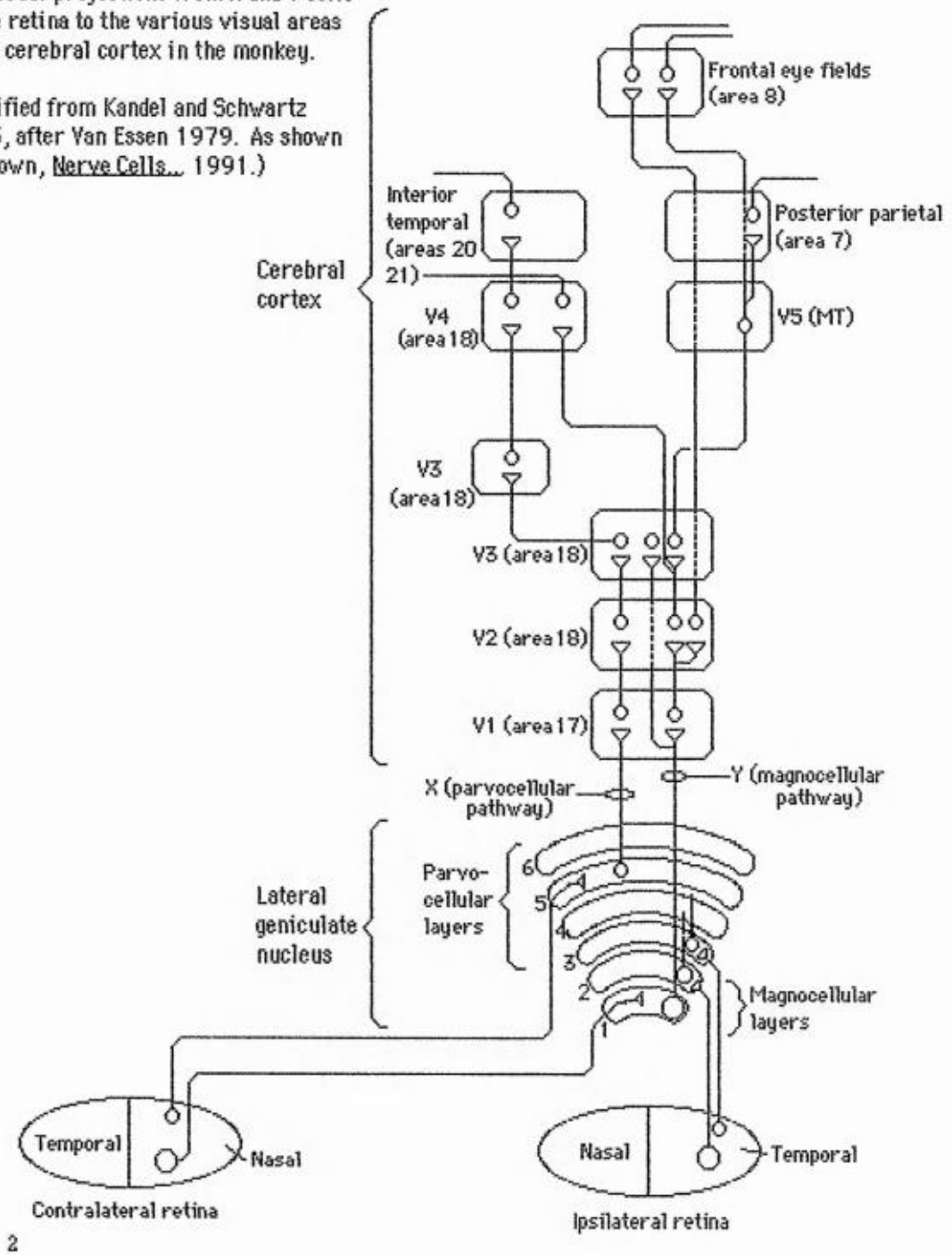
[1] Zeki, S. Colour vision and functional specialization in the visual cortex, Vol. VI, No. 2, March 1990, p. 11.

The visual projections from X and Y cells in the retina to the various visual areas of the cerebral cortex in the monkey.

(Modified from Kandel and Schwartz 1985, after Van Essen 1979. As shown in Brown, Nerve Cells... 1991.)



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[2] Brown, Nerve Cells and Nervous Systems: An Introduction to Neuroscience, London, 1991, p. 188. For further information see: Kandel, E.R. and Schwartz, J.H., Principles of neural science, NY, 1985 and van Essen, "Visual areas of the mammalian cerebral cortex", Annual Review of Neuroscience, 2, 1979, 227-263.

It is in the LGN where the visual system begins to exhibit the divisions for processing specific visual characteristics. One subsystem, the parvocellular, deals with the visual identification of colours, patterns and objects while the other subsystem, the magnocellular, deals with spatial relationships and motion. It is at this stage of visual processing that important implications regarding the efficacy of Seurat's theories become apparent.

The parvocellular system resides in the upper 2/3 of the LGN, is comprised of small cells with small receptive fields, has a slow response time even though the acuity is high for stationary objects and, most importantly for this investigation, deals with colour.[3] The magnocellular system, situated in the lower 1/3 of the LGN, has larger cells with larger receptive fields, is very sensitive to achromatic brightness contrasts, has a fast response time and handles motion and stereopsis.[4] Input from both the magnocellular and parvocellular systems then projects to the striate cortex, or Visual Area 1, in a point to point manner.[5]

In the primary visual cortex, the retina is mapped out and "each retinal half and each quadrant can be clearly demarcated."[6] Thus, there is a "spatial pattern of cortical excitation according to the retinal image of the visual field."[7] Although the primary visual cortex possesses this precise representation of the retina, the ratio of representation from the fovea and the periphery is not at all equal.

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3 Zeki, Op.cit., p. 24.
4 Zeki, Op.cit., p. 24.
5 Zeki, Op.cit., p. 25.
6 Kapit, et.al., Op.cit., p. 94.
7 Barr and Kiernan, Op.cit., p. 305.

The primary visual cortex (PVC) is the first visual area of the brain which is concerned with the processing of incoming visual signals; until this stage visual information had only been channeled. The aspects in the first visual area, V1, which are dealt with are: orientation of forms, some wavelength discrimination, some motion aspects and placing of the stimuli within the visual field.[8] V1 maintains a prominent "functional segregation of information" where "pathways for colour and form are maintained segregated within V1...signals related to motion are also segregated from those related to form and colour."[9,10] The reasons for holding this assumption are that there are neurons which seem to be selective for "(1) particular wavelengths (in the blobs in layers 2 and 3); (2) orientation (especially concentrated in the inter-blob regions of layers 2 and 3); and (3) motion (in layer 4B throughout V1)."[11] These anatomical connnections in the visual cortex are depicted below:

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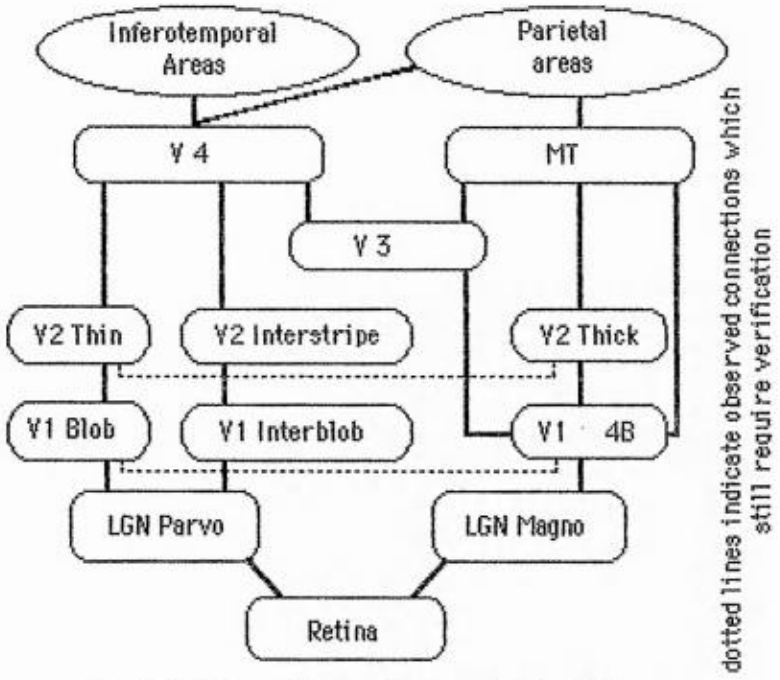
8 Brown, Op.cit., p. 204.

9 H. Livingston, "Art, illusion and the visual system", Scientific American, January 1988, p.69.

10 Zeki, Op.cit., p. 33.

11 Brown, Op.cit., p. 205.



Anatomical connections and neuronal selectivities in the visual cortex [12]

From Visual area 1, the now segregated signals proceed to Visual area 2. V2 is immediately adjacent to V1 in the cortex and the subsystems of Thin, Thick and Interstripe are identified due to the way they stain in mitochondria; the thick and thin areas are separated by two pale interstripes.[13] The V3 complex is orientation selective and specializes in form processing. The Parvo-Interblob-Interstripe system interprets details while the Magno-4B-Thick stripe-MT system interpets the image as a whole. There is evidence that shows the pathways continue along separate channels in Visual Area 4.[14] The V4 complex is wavelength selective and may be compartmentalized since it receives

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12 Shown in Stephen Grossberg, "3-D vision and figure-ground separation by visual cortex", Perception and Psychophysics, 1994, 55, (1), 48-120. Originally from E.G. De Yoe and D.C. Van Essen, "Concurrent processing streams in monkey visual cortex", Trends in Neurosciences, 1988, 11, 219-226. Copyright by Elsevier Trends Journals.

13 Zeki, Op.cit., p. 34.

14 See Semir Zeki, (U. Coll. of London) and Stuart Shipp and John Maunsell and David C. Van Essen (CA Inst. of Tech.) for recent findings.

information from both the thin stripes and pale interstripes.[15] The MT region, also known as Visual Area 5 (V5), is directionally selective since it receives information from the directionally selective cells in 4B and the upper layer of V1. The MT region also deals with movement and stereoscopic concerns.

Therefore,

> ...the cortical colour system is derived from the parvocellular input to the striate cortex, the cortical motion system is derived from the magnocellular input and that there are two form systems generated in the cerebral cortex. One (the interblob-interstripe-V4 system) probably deals with static form, is intimately linked to colour and derived from the parvo-cellular system while the other (layer 4B-thick stripe-V3 system) is probably concerned with dynamic form, is independent of colour and is derived from the magno-cellular system.[16]

There is psychophysical evidence for the separation of form, colour and motion in the human visual cortex. If the characteristics of form, colour and motion are separate, then one should be able to detect the individual components perceptually. For example, if the luminance difference between the stimuli is removed, this will force the human subject to discriminate between the stimuli by differences in colour alone and experiments to test these involve equiluminant or isoluminant colours were pioneered in the 1970s.[17] By making the luminance levels identical, the visual system is forced to determine motion, depth and some aspects of form by relying solely upon colour clues.

For example, a classic isoluminant experiment involves vertical, alternating, identically-sized bars of red and green

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[15] Zeki, Op.cit., p. 34.

[16] Zeki, Op.cit., p. 36.

[17] See Lu, C. and Fender, D.H., "The interaction of color and luminance in stereoscopic vision", Invest. Ophthal., 11, 482-490, 1972.

which are moved horizontally across a screen. When the bars are presented at isoluminance, the motion appears to cease; the motion only recommences when the luminance is changed or when black lines are introduced in-between the red and green bars.[18] So, even though there is physical movement of the stimuli, none is perceived. Furthermore, due to subjects' individual differences, the point at which the motion appears to cease will vary somewhat yet everyone with normal colour vision will experience this strange phenomenon at some stage.

There is a subtle yet important discrimination made in the cells in V4; those which are wavelength selective are not necessarily colour selective. Some sort of (still undefined) change takes place as a result of "a special feature of V4 ... which allows a cell to be influenced not only by what is in its excitatory receptive field, but also by what occurs in surrounding regions, precisely **the condition demanded by colour theory**."[19] These cells have extensive surrounds in order to field the stimlus better; without them, there would be no reaction. "The fact that the responses of wavelength selective cells at lower levels of the visual cortex do not correlate with colours whereas those in V4 do is the clearest evidence that the visual cortex must somehow transform, presumably by a set of comparisons, the information that it receives in order to construct colours and assign them to surfaces." [20]

What conclusions can be drawn from this? The cerebral cortex is an active analyzer of information, it does not merely

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[18] This is a typical example of an isoluminant experiment. The basic presentation and further applications are discussed in Zeki, Op.cit., p. 41.
[19] Zeki, Op.cit., p. 53.
[20] Zeki, Op.cit., p. 53.

channel information along the system. Furthermore, and most importantly for colour research, new constructs are generated from a set of complex interactions and "colour" is one of these constructs.

Lastly, one must be careful to recall that the visual system operates so quickly and so efficiently--taking into consideration all the pictorial components of colour, brightness, depth, and form while also reading a picture as a whole--that it might seem an exercise in futility to dissect the process into its separate segments. Emotional and mental states also affect colour perception and it is difficult to draw the line where one effect stops and another takes over, especially when some effects run concurrently and others consecutively. However, as has been revealed in the past six to ten years of research, there is a definite neurophysiological visual system whose separate pathways each handle specific aspects of vision. Continuing experimentation is providing enough support for conclusions to be drawn and it is this research which will now be considered in terms of Seurat's theory.

Physical Factors and Their Effect on Seurat's Theory

The anatomy of the eye, the processing of the visual signal from the eye to the brain and the general layout of the visual cortex have been presented. It is acknowledged that colour is regulated by factors outside of the perceptual system--such as changing paint composition or other physical attributes--and it is now accepted that colour is also manipulated within the physiology of the eye and brain before being re-constituted in the neurological system. Considering Seurat and his goals, it is not surprising that the more one examines his works the less likely it seems that his theory and the application of it will remain pure and unaffected by any contaminating factors; even one uncontrolled factor will cause the pathway to his end to become irrevocably altered. All things considered, though, the "success" rate of Seurat's theory will now be examined in terms of the previously identified factors.

Under normal conditions, colour matching in the fovea, which is the area of greatest resolution and highest concentration of colour-receptive cones in the retina, is trichromatic. Sometimes, though, since the centre of the fovea has little, or no, blue receptors, colour matching may become dichromatic. This means that some colour combinations from stimuli which fall in the centre of the foveal region will be less effective due to the weakened blue response. Thus, central foveal colour mixing can be achieved with just two colours; the perception of yellows will be good and the blue-greens will be poor.[1]

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[1] E.N. Willmer & W. D. Wright, "Colour sensitivity of the fovea centralis", Nature, 1945, 156, p. 120.

Yet, although there are no "blue" cones in the fovea, we are never aware of this nor, under normal circumstances, are we aware of changes in colour vision for peripheral targets since we normally move our eyes so that the area of most acute vision, the fovea, is fixating on the target. Additionally, having mentioned this finding, which works in controlled laboratory arrangements, it must also be mentioned that artworks will not adhere to rigid laboratory controls. Yet, the fact the Seurat so carefully presented his visual targets for discrimination is reason enough to consider the aspects of foveal mixing--if for no other reason than to provide an explanation for the offchance that one of his colour sets "landed" in this area of the eye.

Another situation concerns images of small field sizes, when images can be matched by only two, instead of the usual three receptors, might be more applicable when viewing Seurat's work. Although foveal mixing involves two colour mixing and small field size images can be resolved with only two of the usual three receptors, they are not interchangable; small field tritanopia is not the same as dichromatic vision.[2]

Small field tritanopia concerns the difficulty of discriminating between colours when they are confined to small patches of light. Since most paintings, pointillist or otherwise, are collections of many small patches of light, the small field tritanopic effect should apply to all paintings equally. The only instance where one might expect a painting to have similar effects to a work created by a tritanope, would be if one had a painting on the head of a pin; then, obviously, the

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[2] D. Heeley, correspondence, 1986.

spots or patches of colour would be too small to be discernable as separate colours.

Even so, the scientific concern regarding the size of the test field or, in Seurat's case, the size of the spots, means that if his spots were too irregular, the above aspects of vision could confound the desired result.[3] Although the absolute size of the stimulus is irrelevant, since the image is described by the angular subtense at the eye, having small stimuli next to large stimuli will present conflicting messages. As has been mentioned, some colours are physiologically impossible to perceive if they are presented in too small a test field since their images would fall in the centre of the fovea.

For images of small (experimental) field sizes and others which fall in the foveal area, the colour matching confounds are as follows: red and green are satisfactory but blue and green may become confused, a yellow-green may be indistinguishable from a blue-violet while an orange may be confused with a reddish-purple; and, lastly, yellow alone may appear light gray while blue may appear dark gray.[4] Therefore, since red and green are the only colours which remain separate and distinguishable, divisionism from a distance or with any other colours, will produce gray tones. It is exactly this grayness or lack of increased brilliance which has remained one of the major criticism's of divisionist colour work.

Analyzing stimuli of the same size, and Seurat did try to produce uniformly sized spots at times, reveals that colour

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[3] See J. Gordon and I. Abramov., "Color vision in the peripheral retina: II. Hue and saturation", Journal of Optical Society of America, February 1997, 67, (2) 1977, p. 202-207 for specific problems of small stimuli.
[4] W. D. Wright, The Measurement of Colour, 4th ed., London, 1969, p. 35.

discrimination in the fovea--except for its centre--is better than in the peripheral visual field. In an experiment testing the the chromatic thresholds as a function of stimulus size and as a function of eccentricity (out to 50 degrees on the horizontal meridian), it was determined that spatial considerations are important to colour perception and the spatial requirements of chromatic mechanisms increase with the eccentricity.[5] In other words, if the size of the stimulus is too small, or if the image falls primarily upon the periphery, the image will appear desaturated and of an indiscriminate hue.[6] As we know, one of the reactions from Seurat's paintings was that they appeared dull and greyish from a distance. Since the cone photoreceptor density packing drops off very rapidly as one moves away from the fovea, increasing the size of the stimulus should improve colour discrimination by, presumably, stimulating the same number of cones as would have been stimulated by the smaller foveal patch.[7] Thus, a regulated presentation of larger dots would have been less likely to appear colourless from a distance.

Furthermore, colour deficiency in the periphery is more tritanlike than deutanlike; i.e., reds and greens are strong while yellows and blues appear colourless. This was confirmed experimentally with small peripheral targets and it was found

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[5] M. Johnson and R.W. Massof, "The effect of stimulus size on chromatic thresholds in the peripheral retina", Documenta Ophthalmologica Proceedings Series, 1982, 33, 15-18.

[6] To support this on a grand scale, researchers sat subjects in front of a white wall with a 10" red circle painted on it. The viewing angle and distance were manipulated so that the visual image subtended 10-20 degrees. By directing the image 10 degrees or more in the periphery, the image failed to be detected; the whiteness seemed absolute. There was no contrast effect picked up at that angle from the fovea thus, "..neurons signaling information about the center of the field are quite uninfluenced by stimuli even 1 degree away." R.L. DeValois and K.K. DeValois, "Neural coding of color", Chapter 5 in Carterette, E.C. and Friedman, M. P. Eds., Handbook of Perception, Vol. 5: Seeing, Academic Press, 1975, p.157.

[7] Heeley, correspondence, 1986.

that hues were generally apportioned between two categories (reds and greens) with the approximate change occurring at 580nm; the normal 570nm marker for yellow appeared gray with longer wavelengths appearing red and shorter wavelengths appearing green.[8]

The different effects of varying illumination is an obvious factor when viewing a painting. The Law of Field Size deals with illumination and the sensations of its change. As the size of the coloured stimulus is increased, there is a real physiological effect from the saturation of a colour even if these effects are technically optical illusions. The effects from afterimages, when surface colours are tinted with the colour of the afterimage, will also create a sensation of an illumination change.[9]

Under normal illumination, the apparent saturation of a colour increases with its presented size from a reasonably small area to one that covers about 20 degrees in the visual field; that is, a red will appear "redder and redder" until it reaches the size of 3.5 inches at a viewing distance of one foot.[10] The hue has little difference here with the apparent "heaviness" of colours increasing as a function of the saturation and decreasing as a function of value.[11]

Another illuminiation variation occurs when the illumination source is not quite bright enough to trigger the photopic system yet is too bright for the scotopic system to become adapted; this

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[8] Gordon and Abramov, Op.Cit., p. 205.

[9] D. Katz, The world of colour, London, 1935, p. 219.

[10] See Faber Birren's History of color in painting, London, 1965, p. 130 for a diagrammatic explanation of this effect.

[11] K.R. Alexander and M.S. Chansky, "Influence of hue, value, and chroma on the perceived heaviness of colours", Perception and Psychophysics, 1976, 19, (1), 72-74.

uses a vision which has been called "mesopic" by some scientists. This intermediate vision would, by definition, encourage a mixed system with both rod and cone receptors contributing to the visual input. Experimentally, this visual process tends to be dominated by the "green" cone response and there is a tendency for the blue colours to appear accentuated in brilliance (compared to the photopic visual system).[12] A perfect example of this is the Purkinje shift when, at twilight, the blues and purples of the spectrum are strong enough to affect and partially override the remaining colours of the spectrum.

The appearance of a coloured area of light is profoundly affected by the wavelengths of other areas of the visual field and is little affected by changes in the illuminating light. Areas of colour which look red in isolation can easily be made to look yellow and this appearance may then be changed from green to red. When considering the effects of colour contrast in paintings, it is agreed that objects, of any size, have their brightness and colour determined by their relation to the surround. Whether it is colour manipulation with lights in a lab or using paints on a canvas, the theories are applicable to both and knowing how an experimental colour is perceived will obviously serve as an aide to artists.

The role of colour in determining a form in space, that is, how colour serves as a cue to pick out an object from its background, is indisputably important. Colour, too, is easier to perceive than luminance but, can colour contrast be compared with luminance contrast? Studies have revealed that "...luminance contrast has an input to the chromatic detection mechanisms"

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12 Heeley, correspondence, 1986.

which suggests that increasing the luminance helps colour detection; yet, the reverse is not true.[13] It has already been explained how isoluminant conditions force the visual system to rely solely upon colour cues to assess motion or depth since, obviously, isoluminance means that luminance contrasts have been removed or destroyed.

Colour alone does not integrate items in a figure, it cannot provide a link between local elements; perceptual grouping tasks are, to some extent, dependent on both colour and luminance contrast.[14] For the visual system to take the presented two-dimensional (2-D) information (the perceptual groups) and read it as three-dimensional (3-D), it has to override some stereoptic effects. This is done via manipulating depth cues such as perspective, the relative size of objects, the relative movement of objects and the shading or gradation in texture of the objects. These cues may seem familiar; they are all handled by the magnocellular system which, as we know, combines all the properties of an object in such a way that enables it to perceive the image as a whole.[15] Further experiments with isoluminance have helped scientists to understand how 2-D paintings and their depth cues are perceived as 3-D.

It is easy to study luminance in achromatic conditions. The difficulty is to "produce stimuli that activate the chromatic pathways but are invisible to the luminance pathway."[16] Luminance

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[13] K.T. Mullen and F.A.A. Kingdom, "Colour contrast in form perception", p. 198-217 in Gouras P. The Perception of Colour, Vol. 6 of Vision and Visual Dysfunction, ed., by John Cronly-Dillon, Oxford: Macmillan, 1992.

[14] M.S. Livingston and D.H. Hubel, "Psychophysical evidence for separate channels for the perception of form, color, movement and depth", Journal Neuroscience, 1987, 7, p. 3455.

[15] See the previous section for the discussion of the magnocellular system.

[16] P. Cavanagh, E.H. Adelson, and P. Heard, "Vision with equiluminant colour contrast: 2. A large-scale technique and observations", Perception, 21, No. 2, 1992, p. 219.

artifacts must be removed completely in isoluminant experiments.[17] Research shows there is"...a 'master' luminance channel as primary for form perception, and for 'locking' the visual colour channels to maintain precise registration of coloured borders."[18] This means that form analysis comes from the luminance channel while the colour system will operate until a change is perceived in the luminance.

At isoluminance, when the parvocellular system is functioning and the magnocellular system has been stopped, the following will occur: direction, movement, depth and lightness and texture cues will fail to be detected by the colour system. If these findings are extrapolated to the world of art, there are some interesting results. Any object which is isoluminant with its immediate background will look vibrant yet unstable and the Op Art of the 70s played upon this factor. This occurs because the parvocellular system detects the shape of the object through its colour but the magnocellular system struggles, and fails, to detect a contrast difference due to the equiluminance.[19] The result is that the visual system cannot function fully and the image "jumps".

Retinal mixing occurs only at suitable distances, unsuitable distances produce either a shimmering quality or flat, non-descript colours. Both of these end products have been used in

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[17] Artifacts are carryover effects due to uncontrolled factors. In the case of isoluminance, deviations within the optics of the eye, technical problems with experiemental lenses and temporal and spatial overlap will corrupt a truly isoluminant situation. For further reading on these problems and their eventual corrections see: D.I. Flitoroft, "The interactions between chromatic aberration, defocus and stimulus chromaticity: Implications for visual physiology and colorimetry", Vision Research, 1989, 29, p. 349 and Cavanagh et.al., Op.cit., p. 219-220.

[18] R.L. Gregory, "Vision with isoluminant colour constrast: 1. A projection technique and observations", Perception, 1977, 6, p. 119.

[19] Livingston, Op.cit., p. 74.

descriptions of Seurat's works. A slightly different adjunct to retinal mixing is fusion and scientists have determined that colour will fuse; though, unfortunately, it is not clear whether fusion is an advantage over luminance or simply equal to luminance.[20] Whether retinal mixing = fusion = "jumping" at equiluminance is moot; the phrases are describing a physiological reaction which produces an altered and, perhaps, enhanced, visual state. Seurat would not have known about the eye as we do today, but he knew enough to affect a very definite reaction.

This section has shown how the main thrust of research, even through the late 1980s, has shown strong evidence for the view that cortical visual pathways handle separate information for form perception and for function perception. This means, basically, that although the visual system processes different aspects of vision via two separate and parallel channels, it processes them simultaneously. The implications at this level of visual processing for Seurat's work are numerous.

Seurat would have unknowingly triggered both systems since his controlling factor of colour was in one channel yet his goal of altered or increased brightness was managed by the other channel. Seurat's focussing on the one channel dealing with colour, while he susequently activated the channel dealing with brightness and stereopsis as the system read the image as a whole, would create an unstable overall response. One channel would be triggered before the other one but, and this is the crux of the problem, the increase of luminance would temporarily cancel out the colour channel. This would repeat ad infinitum. Thus, rather than a simultaneous processing of information,

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[20] Mullen and Kingdom, Op. cit., p. 214.

Seurat's goal of increased brightness via colour control would elicit a sort of out-of-synch processing. Even if the timing was only out by milliseconds--and the time variations in such cortical processing would be infinitesimal--it would be enough to produce inconclusive visual responses as the system worked and then failed alternatively. This could be the reason for the flicker or shimmer which was visible in some of Seurat's paintings when they were freshly painted.

This may seem like conclusive evidence for the "success" of Seurat's theory and, indeed, there does seem to be a sufficiently tidy explanation for what may be happening. However, an interesting twist in the research on colour vision, especially in the cortical processing level, may throw this agonizingly reached conclusion into disarray.

The "twist" has developed out of a re-examination on the initial 1987 landmark research done by Livingston and Hubel which established the concept of a parallel processing system.[21] Their hypothesis mapped segregated pathways from the retina through the higher cortical areas and provided a new approach to perceptual psychology by offering "the missing link between brain circuits and perception."[22] Livingston and Hubel's work was based upon the assumption that the system carries information which can be detected from single cortical neurons. In other words, they hypothesized that by monitoring the activity of specific cortical

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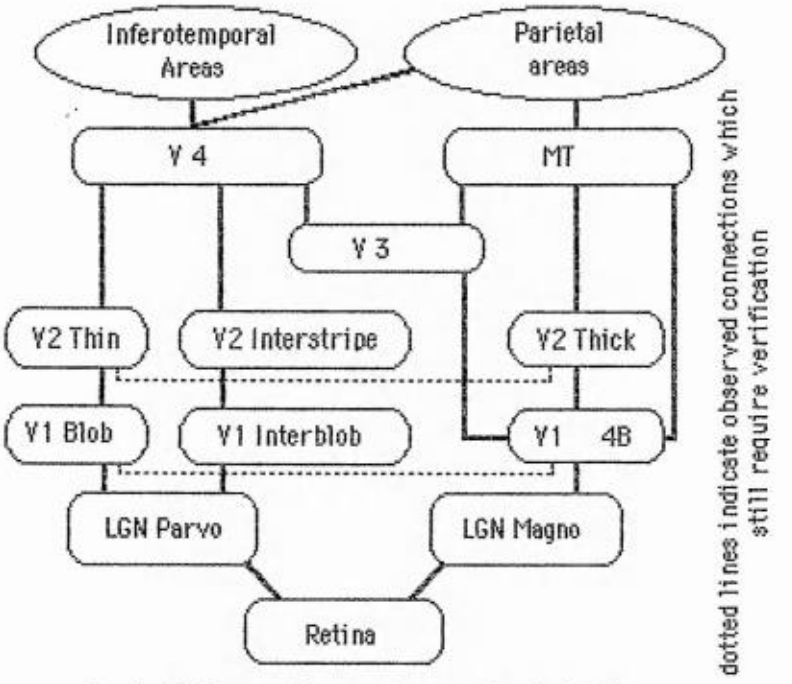
[21] Livingston and Hubel, Op.cit.. Livingston and Hubel's work was the first to outline parallel processing although numerous other researchers were working along similar lines. There have been many publications subsequent to their piece and the concept of parallel processing has become so accepted it has been, until very recently, taken as gospel.

[22] Martin, K.A.C. "Parallel Pathways Converge", Current Biology, Vol. 2, No. 10, 1992, p. 555. See also Livingston, M., Hubel, D.H. "Segregation of form, color, movement and depth: anatomy, physiology and perception", Science, 1988, 240: 740-749.

neurons, the effect on vision from controlled stimuli can be assessed. The entire premise of a parallel processing system was based upon this neuronal doctrine and it is this selfsame doctrine which is now being questioned and slowly attacked. One of our initial diagrams of the neuronal connections in the visual cortex (shown below again for handy reference) indicates some crossover between the channels in the form of dotted lines. This hypothesis is now



Anatomical connections and neuronal selectivities in the visual cortex [23]

believed to be too exclusive since experimental evidence shows there is input from the magno system to the colour pathway, for example.[24] (my emphasis)

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[23] Shown in Stephen Grossberg, "3-D vision and figure-ground separation by visual cortex", Perception and Psychophysics, 1994, 55, (1), 48-120. Originally from E.G. De Yoe and D.C. Van Essen, "Concurrent processing streams in monkey visual cortex", Trends in Neurosciences, 1988, 11, 219-226. Copyright by Elsevier Trends Journals.

[24] Martin, Op.cit., p. 556.

Not only has very recent evidence from physiological studies as well as "..anatomical confirmation of a convergence of the M and P pathways within the 'color' system in V1..." thrown suspicion upon the accepted system, the entire notion of parallel systems is now in doubt.[25] The basic premise of a neuronal doctrine becomes far too unwieldly if its use throughout the system is considered. That is, it is more than probable that single neurons transmit via some local circuits or clusters in order to reach one of the 30 visual areas in the brain and, considering that millions of lines of "information" are transmitted at the rate of 4 bits per second, there must be a prerequisite of some sort of clustering/organizing network just to manage the enormous mass of activity.[26] Today's researchers now feel that the individual neurons must be interconnected, perhaps at several different places, in order to respond to all of the features to which they are attuned; a concurrent processing of colocated features seems a certainty. However, while the researchers await verification for their new suspicions in the visual cortex processing, we will consider our argument, as far as Seurat goes, complete. At least, until later.

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[25] See any or all of the following: Maunsell, J.H.R., Nealey, T.A., DePriest, D.D. "Magnocellular and Parvocellular contribution to responses in the middle temporal visual area (MT) of the macque monkey", Journal of Neuroscience, 1990, 10: 3323-3334; Ferrera, V.P., Nealey, T.A., Maunsell, J.H.R. "Mixed parovcellular and magnocellular geniculate signals in visual area V4" Nature, 1992, 358: 756-758; Girad, P., Salin, P.A., Bullier, J. "Response selectivity of neurons in area MT of the macaque monkey during reversible activation of area V1" Journal of Neurophysiology, 1992, 67: 1437-1446; Lachica, E.A. , Beck, P.D. Casagrande, V.A. "Parallel pathways in macaque monkey striate cortex: anatomically defined columns in layer III" Proceedings of the Natural Academy of Sciences, USA, 1992, 89: 3566-3570; and Young, M.P. "Objective analysis of the topographical organization of the primate cortical visual system", Nature, 1992, 358: 152-155.

[26] Martin, Op.cit., p. 557. See Appendix M for a discussion of one of the most up-to-date research publications on this issue.

CHAPTER SEVEN

Conclusions

This analysis of Seurat has considered several questions. By asking how the details of Seurat's life demonstrate the spirit of his time, and that is, in some ways, by making his life conform to his time, I have, perhaps, edited the first while reinterpreting the second. Ideally, the identification of any link between the special case of Seurat and the collective times should be nonpartisan. However, it is already partisan to assume that a link between the personal and the collective exists. As soon as I begin to itemize what makes Seurat "great" or "different", I have implicated myself, my temperment and, paradoxically, the outlook of my time through the hubris of my sitting in judgment on the man. I can demonstrate no link between Seurat's life and his times which is free of my biographical interpretation even if this limited interpretation is, paradoxically, a product of my own time. Thus, there can be no interpretation without involvement since it is impossible to determine where the knowledge leaves off and involvement begins.

The very act of writing a biographical report on someone mixes involvement with knowledge since the picking and choosing of "facts" are determined by the presenter. Yet, if we stop to consider this process, we realize that this is how any living person will learn about others, their times or their beliefs; it is an a priori aspect which is recognizable to us all. These same considerations, which serve as guidelines towards the final judgement, can apply equally well to the process involved in an artist's representational depiction of a scene.

There is a sort of selective accuracy wedded to a selective distortion in all representational art. The representation must be enough like the original to start a string of associations in the viewer but, also, enough unlike the original to leave the viewer some room to flesh out and furnish the presentation with his own personal belief. Seurat's art was tantalizingly close to being attainable for the masses but it carried just enough distortion to prevent full and immediate understanding. His earliest audiences must have felt as we do today when the television signal becomes weakened; we can sense what should be there and, indeed, we receive a certain amount of input but we still are frustrated by the lack of a clear and easy-to-understand transmission. Seurat's uncompromising drive regarding his technique cost him his audience appreciation and acceptance, such as it was, was slow in coming.

With the above constraints in mind, a further consideration is whether it is better to enjoy art simply through the impact on the viewer or whether it is better to know something of the milieu of artist and the reason for its creation. One might argue that a picky analysis takes all the fun out of enjoying paintings and this is true, to a degree. However, since the artist under study, Seurat, made a determined effort to leave the realm of all that is subjective, artistic and creative to draw upon the empirical findings of science for his inspiration, I truly believe that an analysis of this kind is justified. One must step back and look at all of the arguments and try all of the angles and combinations therein, before dealing with the input and aiming towards a conclusion. Since Seurat so purposely

toyed with scientific influences, one cannot analyze his works on artistic merit alone.

Yet, conversely, it must be emphasized that although science did influence Seurat, it did not strictly confine and direct the artist's approaches; colours vibrate not from the optical mixture science offers but from the broken colour application which Blanc had taught and Delacroix had used; colour contrasts are employed not because Chevreul dictated it so but because Seurat's artistic tendencies and inclination to do so were furthered and supported by such scientific evidence.[1] Seurat found evidence for his craft in the writings of Rood, Chevreul, Blanc, and Henry; he used what he could immediately apply to his work and thus avoided serious theoretical investigation.

Homer has stated that Seurat attempted to handle the entire canvas surface of La Grande Jatte "according to a consistent set of laws of optics and physics proposed by such scientists as Rood, Maxwell, Helmholtz and Dove."[2] This assessment is far too strong, since it implies a surity in Seurat's technique which was not evident until several years later. With La Grande Jatte, Seurat is only beginning to incorporate laws from science with his artistic intuition to produce something which neither science nor art could produce on its own.

Without written verification of Seurat's step-by-step intentions, we must question what it was that Seurat really wanted to achieve with his divisionism. As Rood pointed out, amongst others, it is true that a pointillistic mixture of two colours will appear lighter than a mixture on the palette of the

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[1] Herbert, Georges Seurat: 1859-1891, 1991, p. 173-4.
[2] William Homer, Seurat and the science of painting, Cambridge, MA, 1964, p. 114.

same two colours; this, in itself, is preferable but it is still not as desirable as an additive mixture of the brightnesses of lights. The confusion arose when Seurat and his group failed to grasp that pointillist colour mixing is the subtle intermediate step between the lowest or dullest palette mix and the highest or brightest light mixture. And, it does not follow that this intermediate and lighter pointillistic mixture cannot be matched by some other mixture from the palette. Regardless, the basic and misguided notion that pointillistic mixing provided desirable if not unsurpassable benefits over light mixing has persisted. It was embraced by Seurat, his friends, and followers, and has rarely been questioned since then.[3]

Seurat slowly adapted his brushstroke towards a more pointillistic dot under the presumption that he could obtain better effects than he could by manual mixing on the palette. This was because, in part, Rood had said such a technique would be like working with small dots of light and the outcome would be the same. However, it is generally accepted that "...his technique did not produce its theoretically conceived benefits."[4] Combining dots was not synonymous to combining lights, the best outcome from such an approach was the more luminous resulting flicker from a partial optical mix. Although Seurat made full use of such a lustre from 1886 onwards, with respect to brightness or purity, pointillism was not indisputably advantageous over traditional methods and, if Rood had been

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[3] Callen states that Seurat believed that the rays of light emanating from the coloured spots were not meant to recombine in the eye with a greater intensity than the original components, that he was seeking the flicker. I am not so sure I agree this, especially at the earlier stages of Seurat's career. See A. Callen, Techniques of the Impressionists, London, 1982, p. 113.

[4] Alan Lee, "Seurat and Science", Art History, June 1987, 10, (2), p. 210.

clearer this issue, the course of Seurat's career might have been quite different.

Furthermore, the principles of optical mixture do not explain Seurat's technique of varying the sizes and shapes of his dots; indeed, they stress the need for regularly sized and shaped dots. Even though his mature works exhibit a more systematic apportionment of strokes, the variance of dot sizes over the canvas, between different colours on the canvas, and the directionality of strokes still exists. If Seurat had eventually intended for some physiological process to take place when someone viewed his paintings, the stimuli as presented would have to have had the same constancy in size and application; irregularities in size, thickness of application, surface finish and shape would all affect the visual process.

Although Seurat sought scientific input, I do not feel that he had enough of a grasp of the scientific principles to formulate something as implicity specific as "Seurat's colour theory". Even then, the scientific principles Seurat had mastered have been applied through the filter of his personality. I feel Seurat was a keen observer of visual phenomena and had the skills to effect some of them as well as the humour to play with his audience, science merely aided and abetted his endeavors. For example, Seurat played with the lights and the colours to such an extent that what you first thought you saw, in effect, you did not and vice versa; the harder you looked, the less apparent things became. Seurat's unique and often ironic approach pulled his viewers up short and made them really stop, look and consider something which had heretofore seemed mundane and boring.

Just as different attributes of the visual system must be assembled together for the system to work properly, the same goes for Seurat's work; the components must be presented properly for the results to be reached. Visual attention is not directed on the basis of position or information alone, grouping is important and motion forms constraints over colour and form feature integration, for example, and this can be extrapolated to Seurat's pieces.[5] None of his factors of complementary colour usage, stroke definition, stroke direction, haloing, figure flattening, distorted perspective and border manipulation are superior; they all work together to form a whole. It is only when one factor becomes predominant that the careful balance is upset and the processing of the image as a whole may become impossible.

We have demonstrated how Seurat's unique style of drawing provided the ideal basis for his transition into colour. By using conté crayon on a very rough paper and by varying the pressure, Seurat easily controlled the amount of crayon deposited on the paper's surface: some areas are almost black with the conté crayon filling every crevice of the paper, while the others are lighter with only the top tufts of the paper retaining any crayon. He mimicked these effects with his subsequent intriguing combination of colours and brushstrokes in layers which "facilitated the interpenetration of light and shade and their subtle reflections and interactions".[6]

The effect in his drawings from the indeterminate shapes existing within a swirling atmosphere is achieved similarly in

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[5] Bayliss, G.C., Driver, J., and McLeod, P. "Movement and proximity constraint miscombination of colour and form", Perception, 21, No. 2, 1992, p. 209.

[6] Rewald, The History of Impressionism, 4th ed., London, 1973, p. 512.

the paintings through a select use of colour and lack of detail and contour; when shapes seem too discernable in the paintings due to their colouring, incomplete optical fusion curtails the clarity. The only difference is the transitional loss from the drawings which are "...really spontaneous, free of the compulsion of theoretical justification..." to the paintings which are planned and controlled to the -nth degree to achieve the same visual effects.[7] Yet, both the drawings and paintings have figures which are substantial and rather eternal in presentation; without any distracting details, the figures become timeless. Such techniques are Seurat's means to his end goal of the visual effects of colour and the process involved therein.

Colour has fascinated man for centuries. Key turning points in the last few hundred years of colour research can be marked by Newton's observations, Helmholtz's experiments and so forth. Such is life. Man questions and defines the unknown with what he knows in an attempt to understand. A quote from an eighteenth-century researcher reveals his on-going search about colour within the limits of the knowledge of his time:

> ...why since the light that is modified in these colours consists but of corpuscles moved against the retina or path of the optic nerve, it should there not barely give a stroke, but produce colour; whereas a needle wounding likewise the eye could not produce colour, but pain?
>
> (Sir Robert Boyle, 1744)[8]

This is an extreme example but, until a "discovery" was supported by research and eventually absorbed under general "knowledge", any query was equally valid. Even with these considerations and

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[7] Michael Zimmerman, Seurat and the art theory of his time, Antwerp, 1991, p. 9.

[8] Robert Boyle, The works of the Honourable Robert Boyle, Vol. II, London, 1744, 34.

restrictions, Seurat's colour works represent educated, calculated and skillful renderings of what was possible with the materials, the science and the approaches of his time.

It is known that one of the approaches which Seurat used was offered by Blanc. Blanc represented a commmon-sense stance in that he argued for scientific understanding and how it affects artwork while also reminding the artist that there were pictorial concerns where the artist would be unable to apply the science directly. Yet, even with Blanc's scientifically-oriented techniques regarding gradation and optical mixture, Seurat continued to apply them in a more painterly manner than scientific. In fact, Blanc's few specific directions for artists, such as using stars for the optical mix, were not followed by Seurat who developed his methodical approach from a synthesis of several ideas rather than from this one specific source.

It is not disputed that Blanc contributed to part of Seurat's intellectual foundation. Perhaps Seurat's reading of Blanc did help him to develop a sort of intellectual habit wherein he always sought to create some sort of balance between the pragmatic pictorial concerns and the more overtly theoretical concerns. Even with the later, influential writings of Rood and Henry, Seurat still sought to maintain the balance between making a picture and using science.

When mentioning the influence of Blanc upon Seurat, the equally strong influence of Humbert de Superville upon Blanc must be reiterated even though the application of the original ideas has become corrupted as it has passed on. Seurat's great emphasis on the linear influence in his later works would seem to

be a direct result of Humbert's ideas. Yet, Seurat seems to have a different purpose in mind: Instead of "a trinity of elements composing one, Seurat has three disparate members. The horizontal is perceived by him to be a separate entity beneath which the diagonals perform."[9] Humbert, and then Blanc, stressed the vertical axis as being the predominant and guiding force; while Seurat focussed on the horizontal and moved the horizon up or down to set the tone of the piece. Furthermore, in Seurat's later pieces, he uses only three schemeta on the human face and, although these are specifically influenced by Humbert's ideas, using just three forms is quite meaningless "...unless one understands the origin that motivated their choice and the psychology behind our response to them."[10] Lastly, regarding Humbert's suggested hues, Seurat's hues simply do not match and, again, their choice came about from a different motivation than that which Humbert had originally recommended. So, although the direct application of Humbert's ideas may not be immediately discernable in Seurat's earlier works, the influence of them does become more obvious.

In-depth examination of Seurat's works reveals the changing aspects of his technique while also showing us how he eventually employed the ideas of Humbert, Blanc, and Henry.[11] For example, in La Grand Jatte, there is no sense of the brushstrokes and, more specifically, differently coloured brushstrokes, going in specifically expressive directions in the Henry manner. Though there are directional brushstrokes in La Grande Jatte, they are

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[9] Barbara Stafford, Symbol and Myth: Humbert de Superville's Essay on absolute signs in art, London, 1979, p. 182.

[10] Stafford, op.cit., p. 183.

[11] This, of course, is presuming that what we are reading as evidence of these theories is actually what Seurat intended.

used primarily to define form. It was not until Les Poseuses of 1888, that Henry's influence becomes apparent. This was also the time when Seurat's re-readings of Blanc--which employed Humbert's suggestions on physiognomy--were at last put into use. The optical and physical laws on colour, the aesthetics of line and movement, and the emotional effects of colour are an awful lot to manipulate, let alone control simultaneously and effectively. Considering that changing just one aspect of the formula will impact all of the remaining factors, makes Seurat's attempts all the more worthy.

One last comment regarding Seurat's concern for the expressive qualities of line and colour. Designs and the directions within them are unchangable. Once a design has been laid out, or thought out, that is it; alteration of any one component changes the design. Similarly, a direction is focussed and pure; one cannot have a "slightly horizontal direction"; horizontal is horizontal. Granted, lines may be moving upwards or downwards with varying degrees but it is always possible to discern the basic direction of "up" or "down". Upon this quite solid groundwork of design and direction is laid the lighter, delicate and more variable framework of valuation and colouration; these are the aspects which allow for and, indeed, demand the fine-tuning of any piece of art. And, it is the entire package which makes up the whole of Seurat's later works; neither colour nor line can be analyzed independently of the other.

Most people realize that grass, a flower and the earth appear as different colours even though they are all illuminated by the same source of sunlight; it remains for the artist to

understand some of the physical principles involved before trying to translate them via some colour approach or theory. In order for light to be reflected, it must first be absorbed by a body and then reemited. "The light that comes out may be at the same wavelength at which it was absorbed, or at a different wavelength. When we look at the object, then, we see light that is characteristic of the atoms in the material, and not necessarily of the light that is striking it."[12] If an artist understands some of these physical properties of light and how colours change in different circumstances, he should be better able to more accurately depict what he sees.

However, the converse may be true; having a little knowledge might be worse than being blissfully ignorant. For example, if we presume that Seurat eventually understood that the primaries in the additive colour system were the same as the mixed results of the primaries in the subtractive system, and vice versa and, if he recognized that there was a decreased brightness in pigment mixtures--even optical ones--versus light mixtures, does this explain why he added white to his pigments?[13] Was it to brighten the mixtures? Seurat may have been working with a carryover from his classical training of having thick and creamy light colours or he may have been compensating for a lack in his materials. Without Seurat's written explanation for this step in his colour mixing, we will never know for sure.

Seurat's addition of white does find support in Hering's theory, as we have discussed in Chapter Four. White, for Hering,

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[12] Trefil, J. 1001 Things everyone should know about science, New York, 1992, entry 374.

[13] See Sherman, Colour vision in the 19th Century: The Young-Helmholtz-Maxwell theory, Bristol, 1981. Though such a maneuver found no support in the research of either Young or Helmholtz, it would, sometime later, be approved of by the research of Hering.

indicates brightness in the black/white colour pairing as well as being "..a result of equilibrium between opposing processes, of a neutralization which occurs between the chromatic complementary components of a complex radiation".[14] And, as we have seen from further research this century regarding Hering's premises, there is a brightness aspect found in other colour pairs. If white is bright, the addition of white to a coloured pigment would, logically enough, make it seem brighter. This may seem obvious and elemental but it has gone full circle as the original instinctive exercise has now, seemingly, been backed up by scientific research.

Thus, some aspects of Seurat's theory have the stamp of approval and some of his techniques are incredibly effective; but, in the long run has it been determined whether his theory is correct, spot-on, or a success? In the literal sense, what Seurat was attempting cannot be shown by scientific analysis to work precisely for us on the terms he apparently intended; that is, the technique is clearly not a "success" and, indeed, no painting can be a "success" in capturing light through mixtures of pigments.

However, there is an area in the "success" of a painting in evoking space, light, etc., which transcends the literal analysis of optical effects. We seem to exhibit a willingness to collude with the painter in overcoming the theoretical limitations of pigments on a two-dimensional surface. There also may be a kind of "success" involved in the way a painting works as an analogue for seen things that transcends any psychologist's testing of the phenomena. And, of course, there is the final and ever-present

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[14] Kai von Fieandt, The World of Perception, Illinois, 1966, p. 100.

sure-fire test of "success": that of the public acceptance of an artist's works through commercial support or keen interest. Although we know of the initial negative reception of Seurat's works, the 100-year anniversary exhibitions more than attest to some degree of success as hundreds of thousands of viewers "saw" Seurat's career for themselves.

Since these exhibits offered a good representation of one man's work in a collection, it was easier to detect themes, technical changes and approaches when everything was laid out under one roof. Although the crowds attested to the success of Seurat in the 1990's, the ultimate determination of the "success" of his theory still remained unattainable. The evidence of the multiple style influences in the colour section made it impossible to firmly state an "If-then" hypothesis about Seurat's theory because the interference from the other influences always brought in "unless this" or "however" clauses. It seems Seurat was caught short while synthesizing his theory from all of the choice input he had gathered in his lifetime. I could not help but have the feeling that if he had lived another decade or two, some of this confusion would have cleared as he established the best methods for him to achieve his goals.

Admittedly, Seurat's short lifetime had something to do with the public reception of his style; the world had just seven years, from his explosion into the art scene at the age of 24 with Une Baignade to his untimely death at the young age of 31, to come to terms with his radically new pointillist technique. Still, he produced a respectable number of large works and a phenomenal number of studies for each of the masterpieces during this short career. His fanatical approach and careful study of

each aspect of a work before even beginning the final piece harkened back to the academic rigidity he received from the École des Beaux-Arts. However, it was this precise approach to a theory of painting combined with his radical ideas of allowing science to dictate his brush which caught, and held, the world's attention.

Seurat's keen analytic mind and his strong background in a systematic approach to art encouraged him to progress with his theory undeterred. His personal drive and incredible motivation kept him going when a lesser man would have given up. His initial works had received little more than scathing scorn from the the public, and especially the critics, yet he persisted. Slowly, an enlightened few began to encourage and even support Seurat. The synthesis of his theory began to have an effect on other artist's works and Seurat found himself heading a new movement. Unfortunately, just as the denouement was reached, and the world waited breathlessly for the conclusion, the creator died. We'll never know what Seurat would have done in his next five, ten or twenty years of painting, we can only surmise. However, it is a sad commentary that his homeland waited so long to gather together what Seurat did manage to achieve; surely accolades should not be withheld so long for anyone of note, however controversial.

With all of these thoughts fresh in mind, we seem to have come full circle. The synopsis of this situation may be expressed by the following recollection. When I was a child of five I loved to paint and one of my most prized possessions was a box of assorted tempera paints which contained a vivid magenta and a brilliant turquoise. My sister and I always fought over

the use of these two colours, partly because of their vibrancy but more because of their uniqueness; they went far beyond the standard array of red, yellow, green, blue, black and white. We created hundreds of paintings around those two colours and I am sure my poor mother was heartily sick of having to admire paintings of turquoise coloured flowers and feathers on a magenta costumed ballet dancer. Regardless, our attraction toward those two unique colours with their special appeal never faded.

While we painted, we had to constantly change the water in which we cleaned the brushes. Sometimes the water was a dirty red, sometimes a murky green but it always ended up becoming a muddy colour. At the "mud" stage, fresh water had to be obtained to forestall the contamination of our prized magenta or turquoise. We did not question what was going on, we simply knew what to do and when to do it. Mixing colours and maintaining their purity was a concept beyond us then, intuition led our actions.

We created those paintings on any sort of paper and my mother had to keep in a steady supply. I preferred white backgrounds since the colours seemed stronger against white than on the brown ground. Again, I knew what I liked but I did not stop to analyze why. Afterall, why would a five-year old need to concern herself with theories of vision when the act of painting was the sole desire and object of pleasure?

Now, a few years have passed. I still paint at times although being steeped in a sauce of "adultness", I cannot always achieve the "accepted, desired, and proper" method of representation, i.e., usually that of a true-to-life realism while retaining--or re-attaining--the pure joy of experiencing

colour for colour's sake. While my psychology training in colour vision and perception can help me to achieve certain painted effects, that selfsame "helpful" knowledge can also block and confuse my more artistic drives. It seems that the more I know about colour vision, painting, and perception, the less easily I can meld the three into a pleasing whole. Trying to control one aspect through simplification can corrupt the other aspects and it has been said: "Simplification can result in a loss of subtlety, and a move in one direction implies withdrawal from another."[15] This truism sums up my situation and, dare I state it in the same sentence, mirrors Seurat's position.

Obtaining a comfortable balance between multiple aspects is an elusive goal, one which I and thousands of scientists and artists have sought to achieve for centuries and one which, perhaps, Seurat came closest to fulfilling. One can almost imagine the first cave painter squashing a blueberry next to a red ochre-coloured animal on a wall only to have The Brains of the tribe shake his head and grunt that green grass stains would have been more effective. Their argument would have continued until sunset whereupon the painting would have eerily changed colours before dissolving into the darkness completely. Those first artists and scientists vanished long ago yet their arguments still remain compelling and fascinating. The answers? As fleetingly "real" as our original opening rainbow. Real, that is, until a single condition changes.

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[15] Post-Impressionism: Cross currents in European painting, 1979-1980 catalogue, London, 1980, opening commentary.

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(giving date and approximate dimensions if available)

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Figure 15. Contrast-Diagram (from Rood, *Théorie scientifique des couleurs*).

Figure 16. Seurat's Copy of Rood's Contrast-Diagram, Mme. Ginette Signac Collection, Paris.

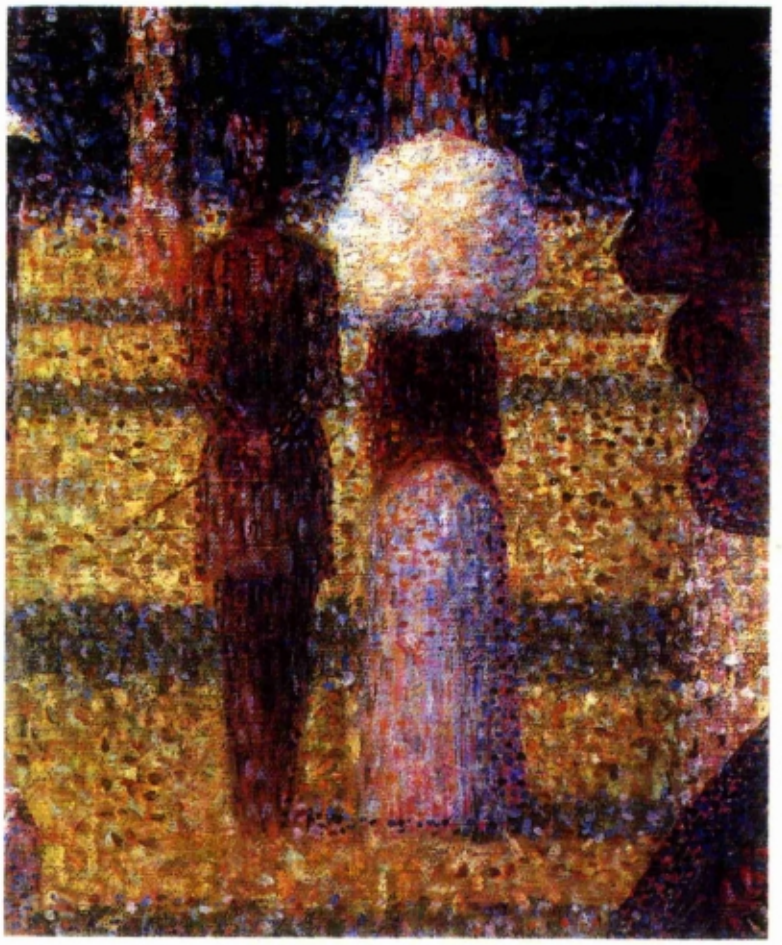
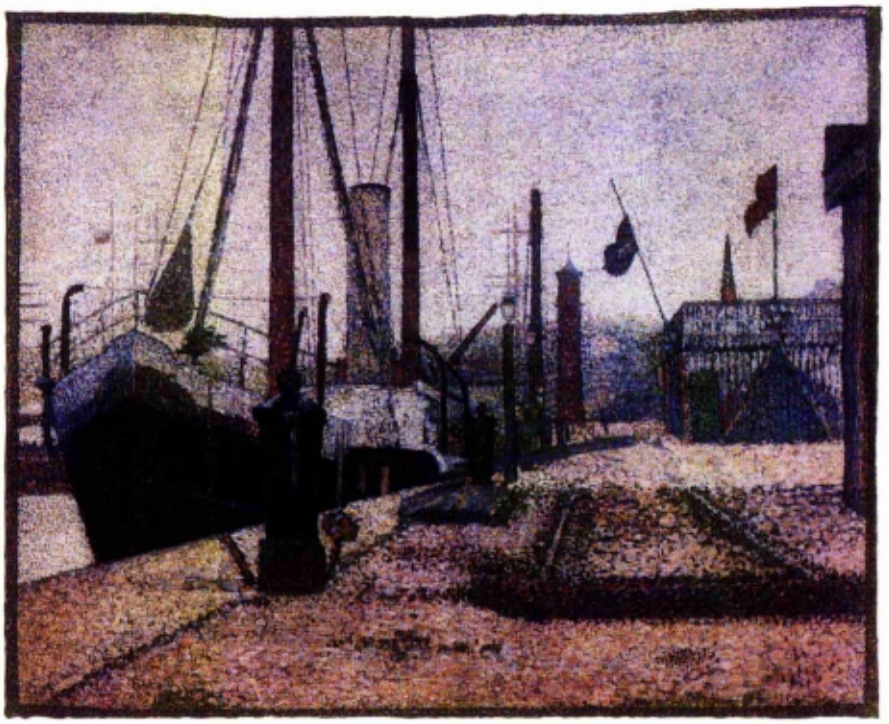


PLATE 9. Georges Seurat. Detail of
the couple in the upper-right section



Photomicrograph of LGJ section, plate 10 of Inge Fiedler analysis

PLATE 10. In this photomicrograph taken from the top of the fisherwoman's hat (see page 174, figure 1), magnified 7 times, can be seen dots that were originally orange and yellow. These almost circular dots, similar in shape and spacing, are a good example of the brushwork involved in Seurat's Divisionist technique and can be compared with his more blended first-stage brushwork for the water at the left of this photograph. Though the dots are fairly closely spaced, the coverage is somewhat incomplete, leaving portions of the first-stage brushwork still visible beneath the small, round strokes.

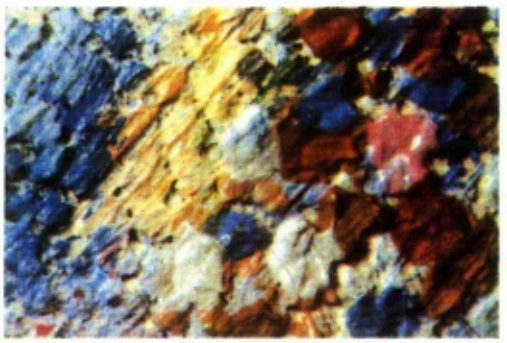
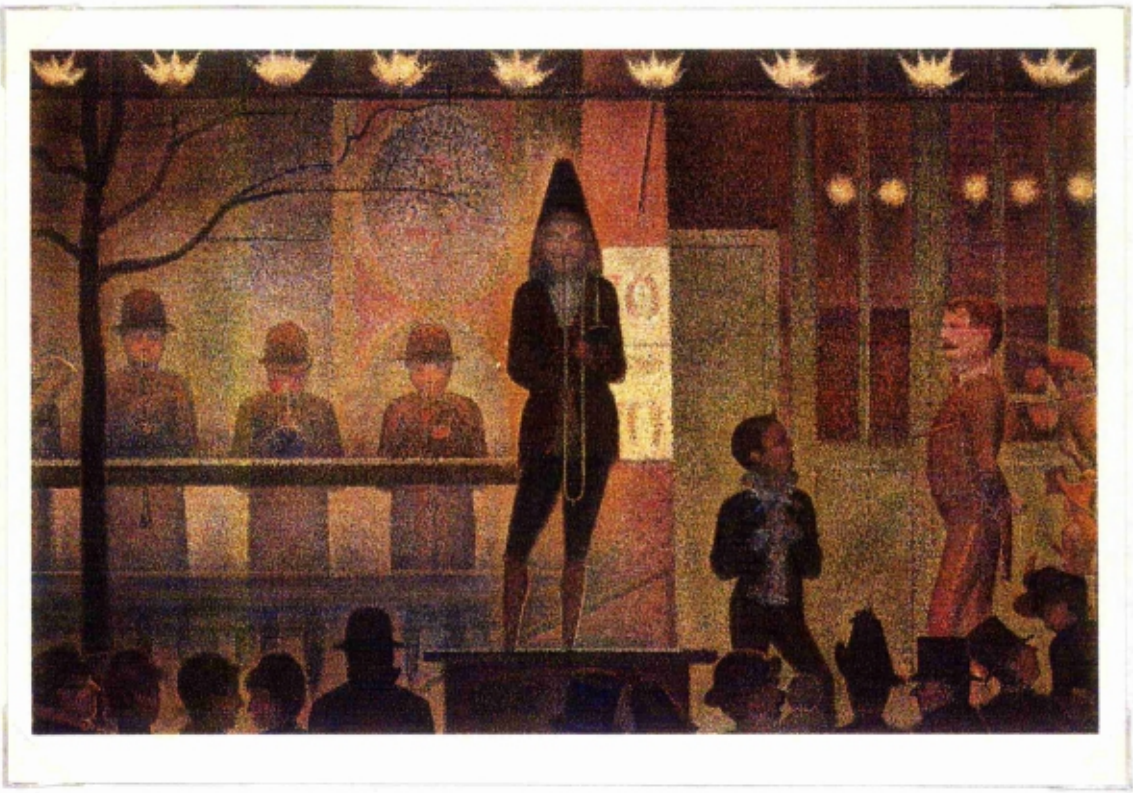


PLATE 11. This photomicrograph illustrates a portion of the boundary between highlights and shadow in the grass at the lower right of the painting (see page 174, figure 1), magnified 7 times. Here there is darkening of zinc yellow dots (to ocher color) and zinc yellow combined with emerald green, which resulted in the olive-green tone mentioned by critic Félix Fénéon in 1892. These two pigments show partial mixing, as is evident by the unblended yellow in the lower portion of the green stroke; underlying first-stage brushwork can be seen as well.

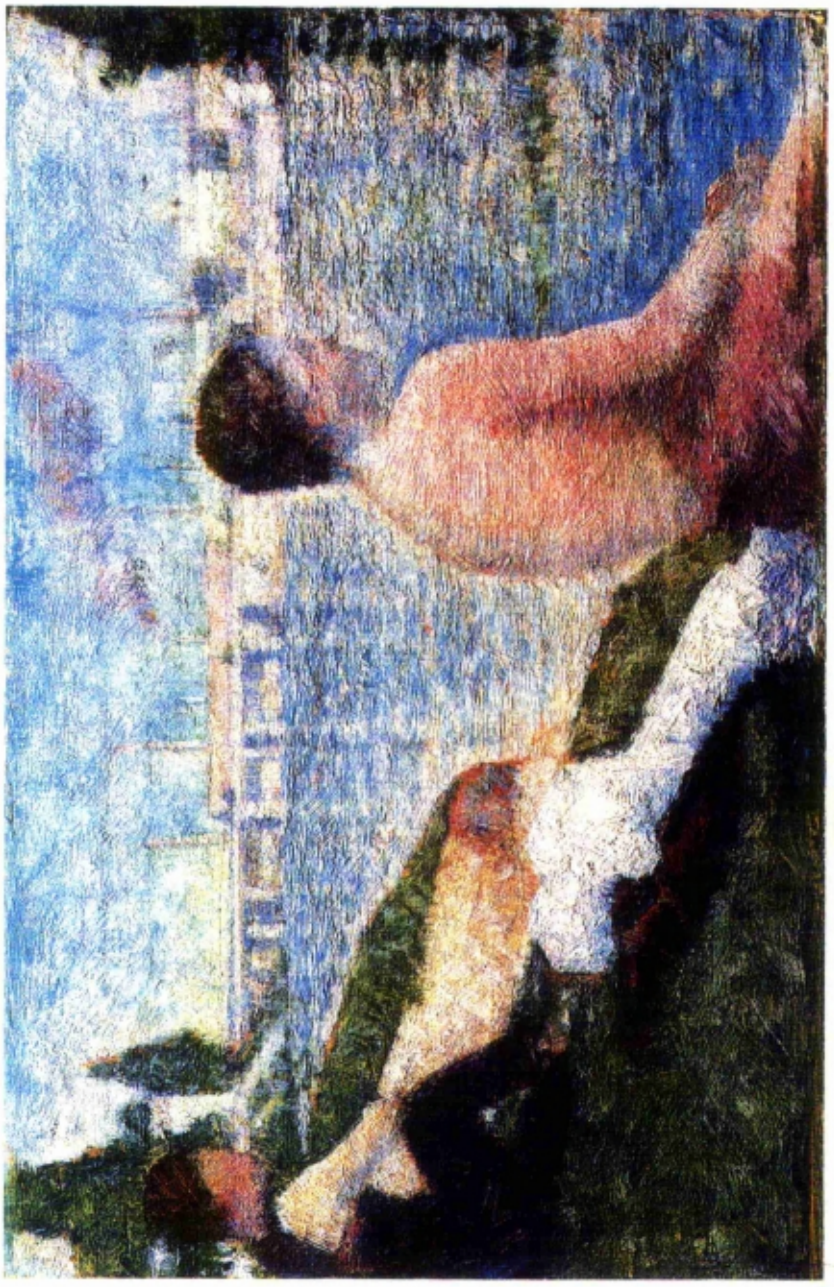
Les Poseuses, small version, 1888

La Parade, 1887-1888

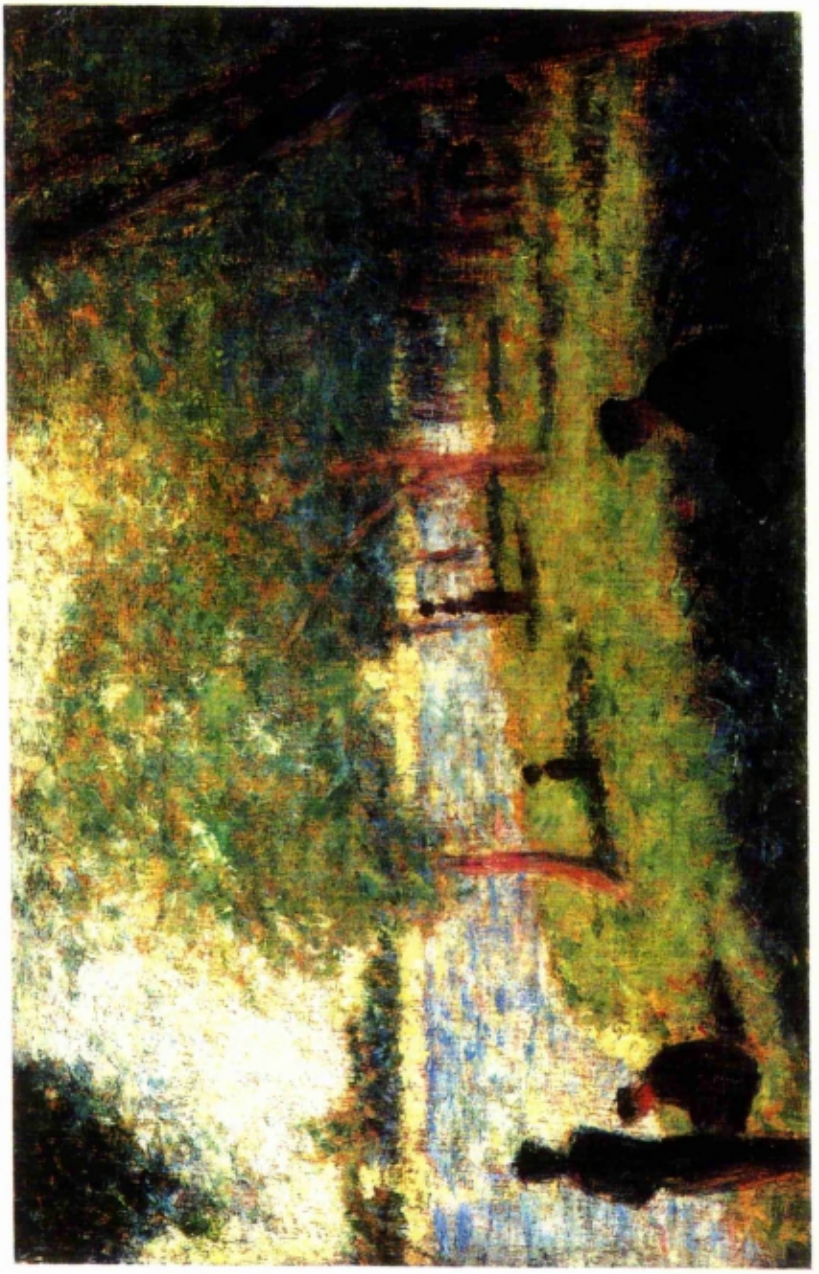


Paysage, l'Île de La Grande Jatte, 1884

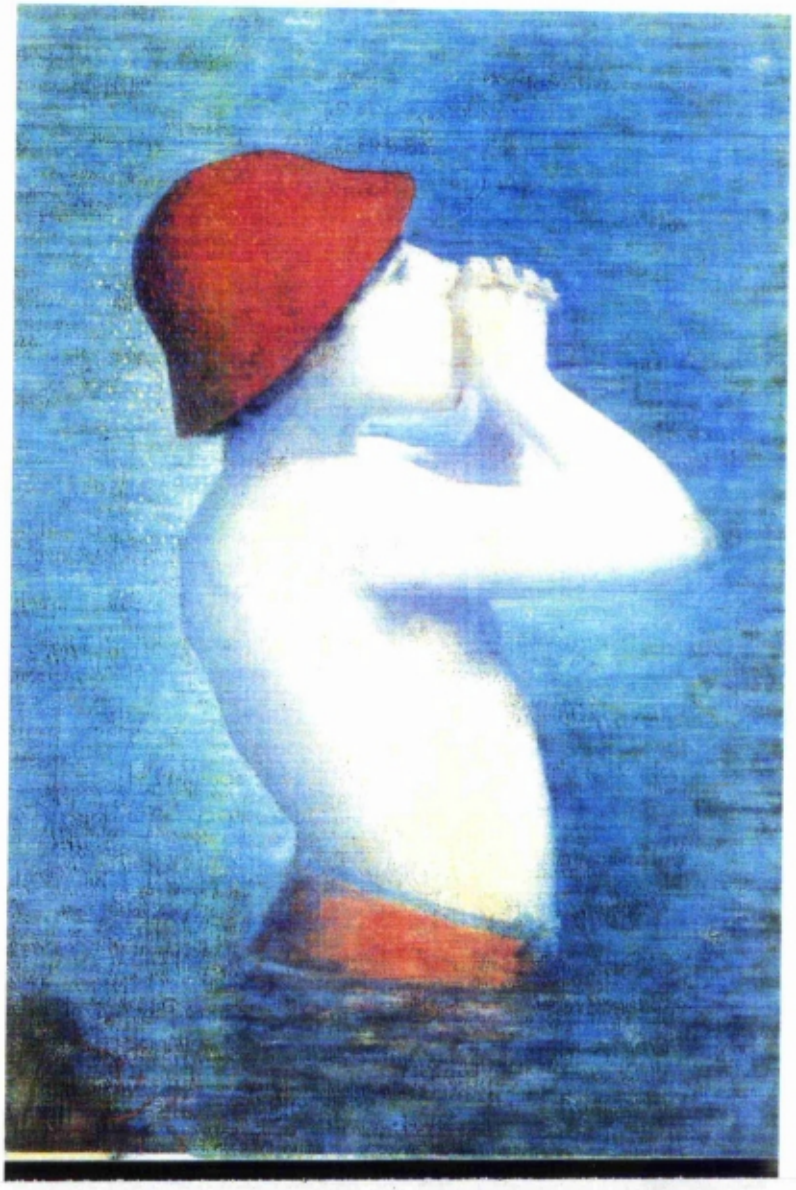
12
Baigneur nu, 1883
compare with Illustration 13



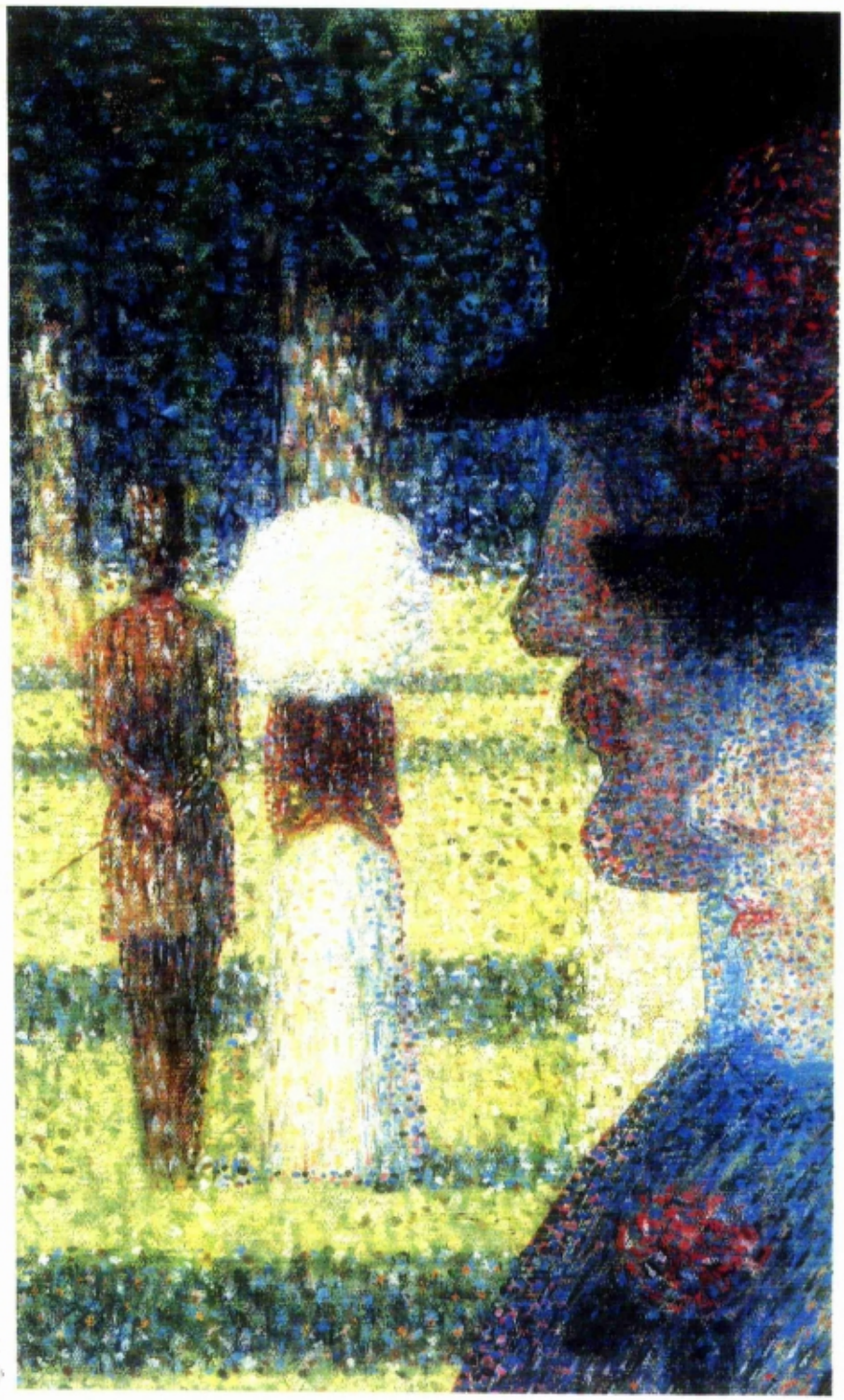
13
Groupe des personnages, 1883-1884



14
Red hat detail of Bathers at Asnieres
compare with Illustration 30

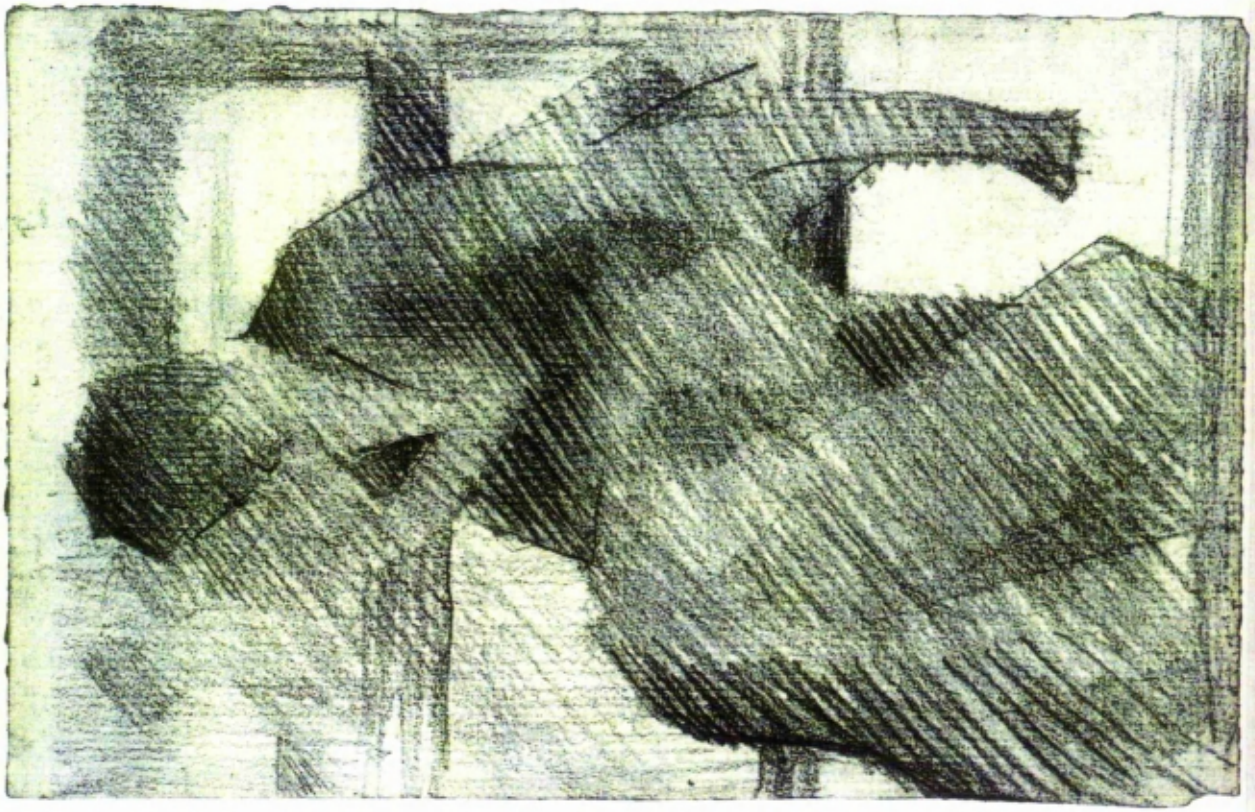


Section La Grande Jatte, final layer

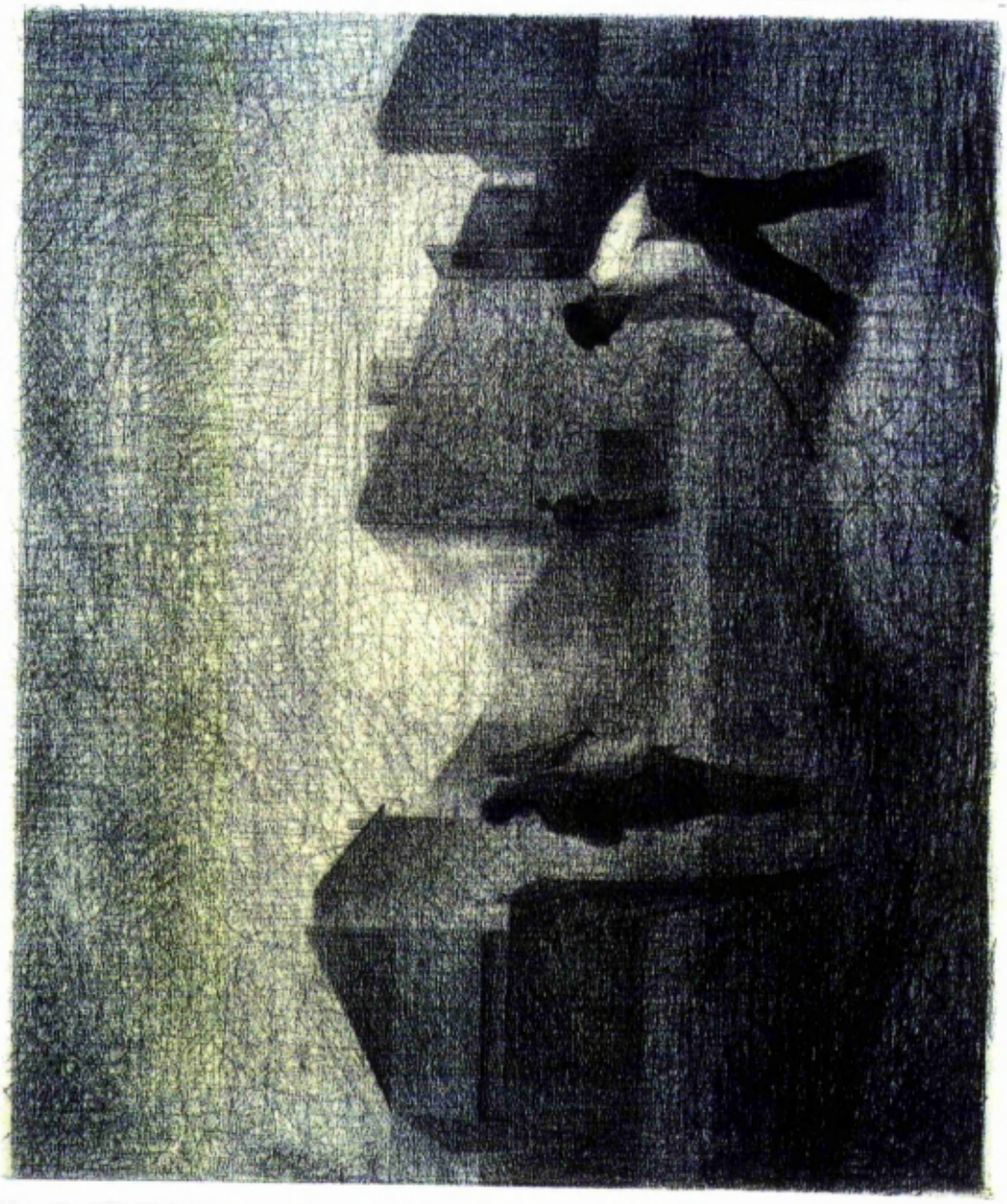


Sous-bois `a Pontaubert, 1881

Femme sur un banc, 1880-81 **AND** Couseuse



Casseur de pierres, Le Raincy, 1879-1881



Silhouette de femme ; La dame joufflue, 1882-1884

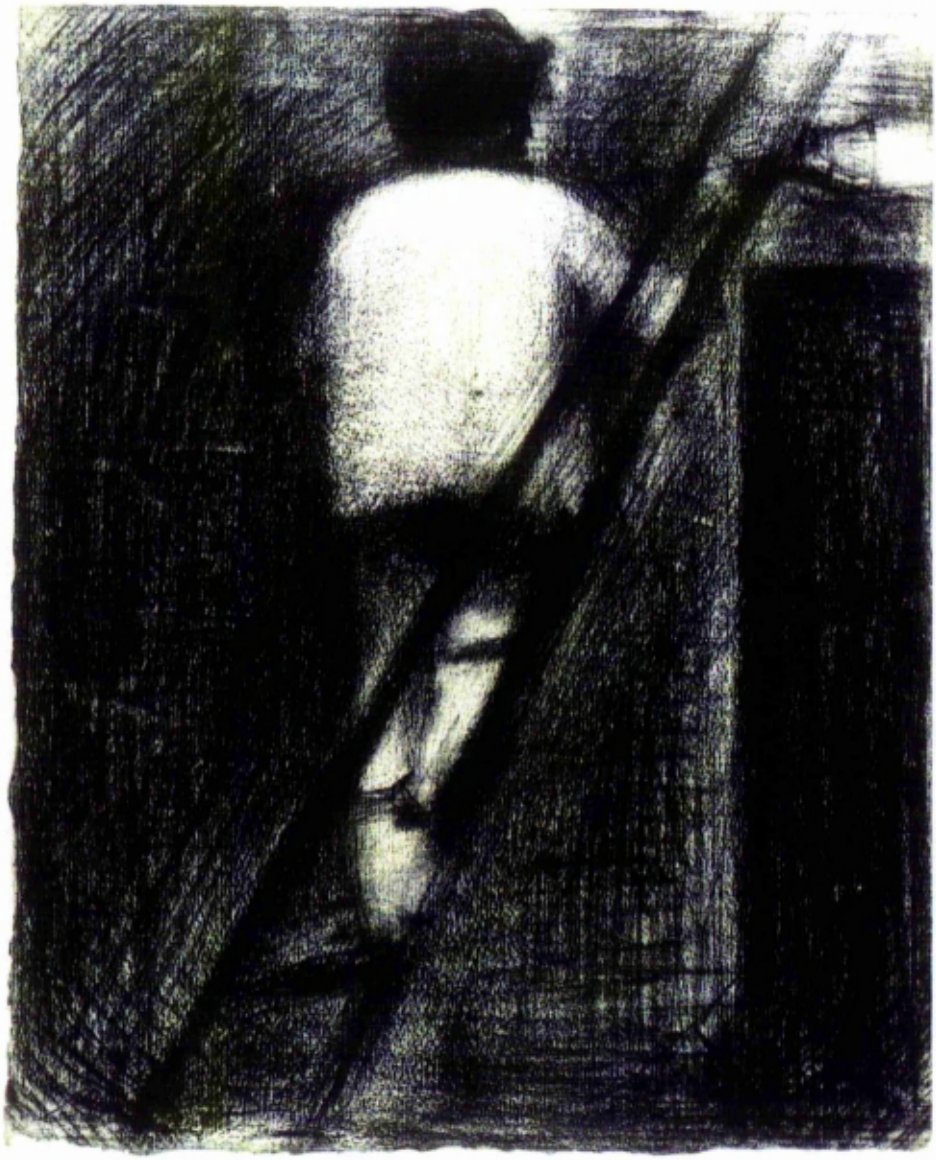
40

Mme. Seurat m'ere, 1882-1883

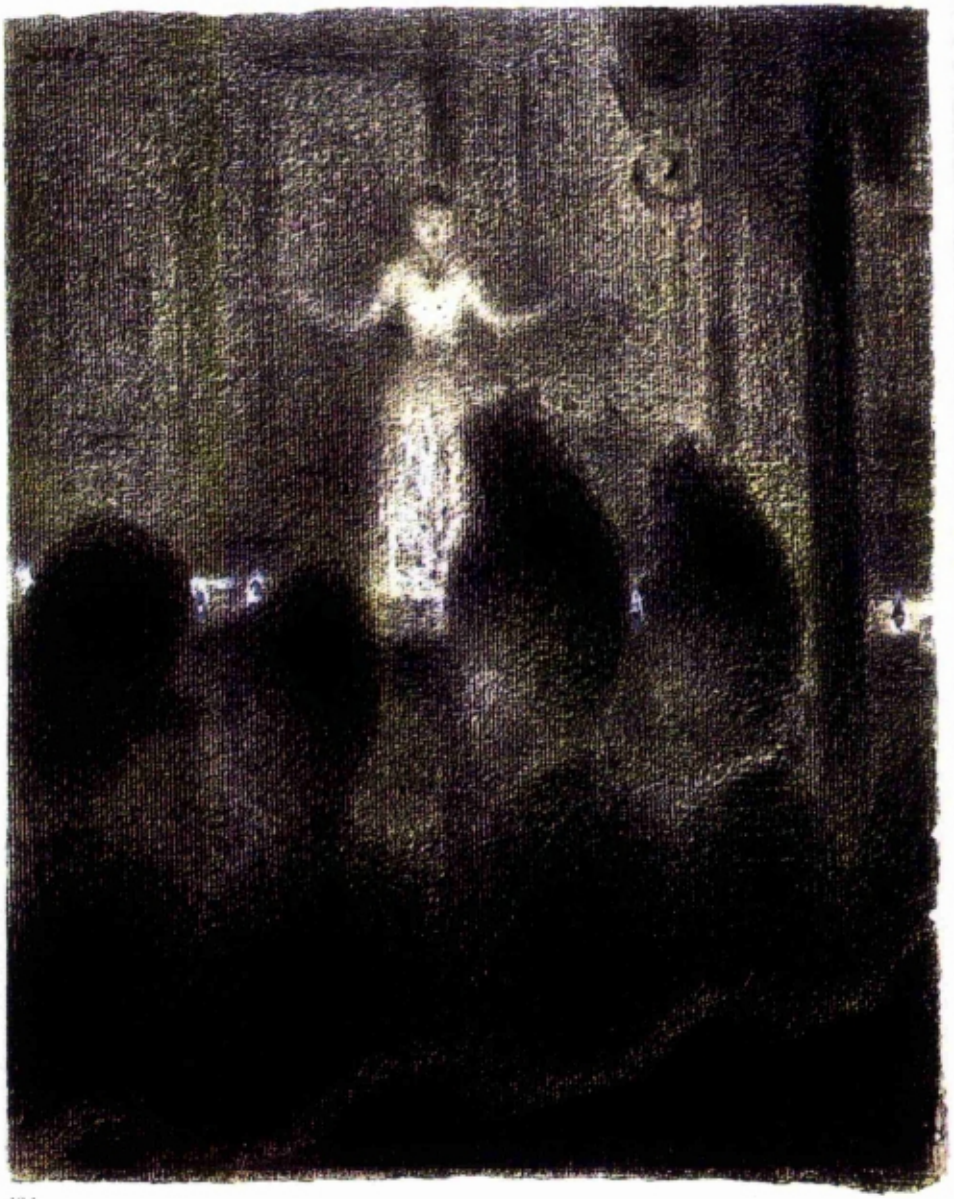
31

21
Le dîneur, 1884

Le badigeonneur, 1883-1884



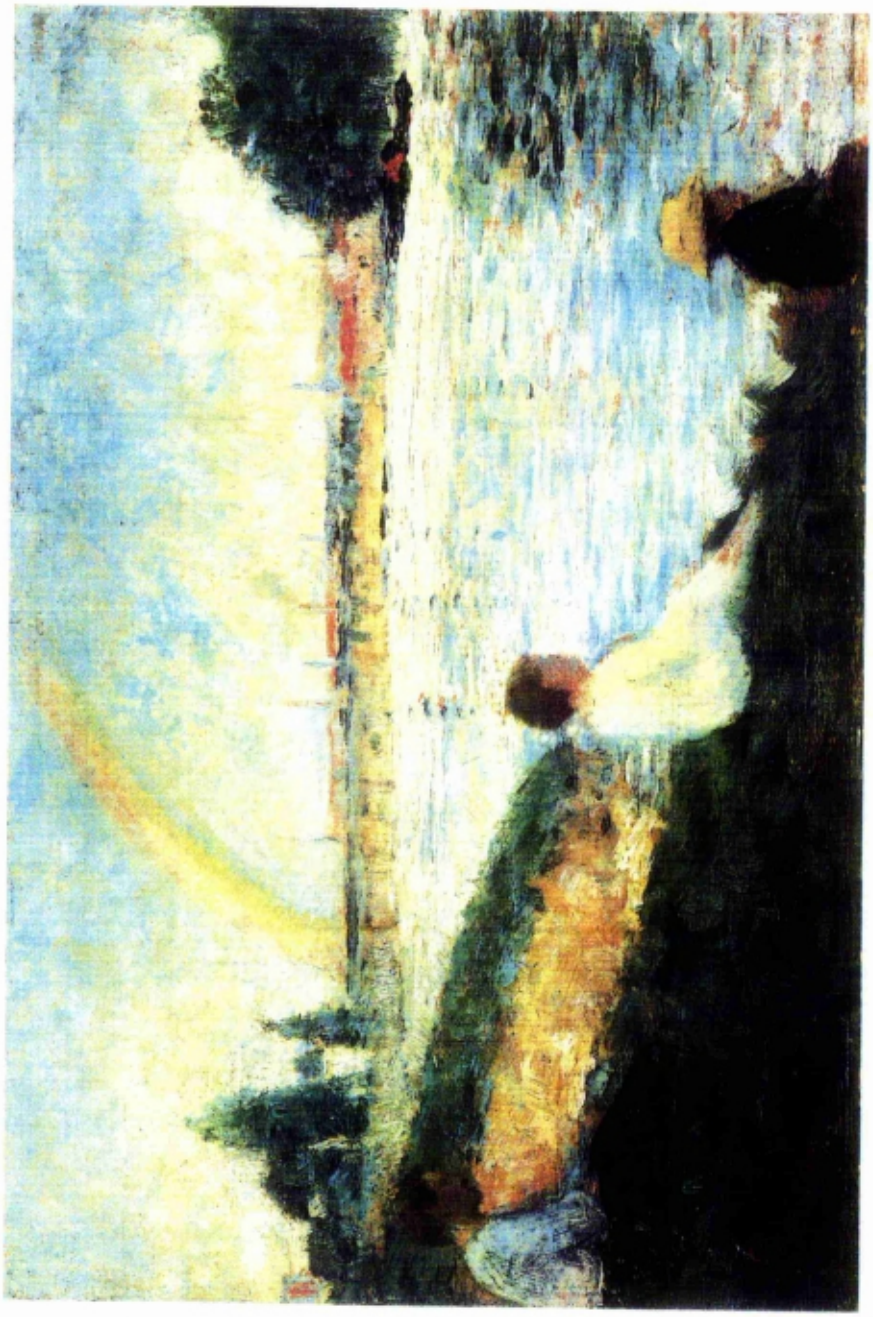
Au concert Européen, 1886-1888



194

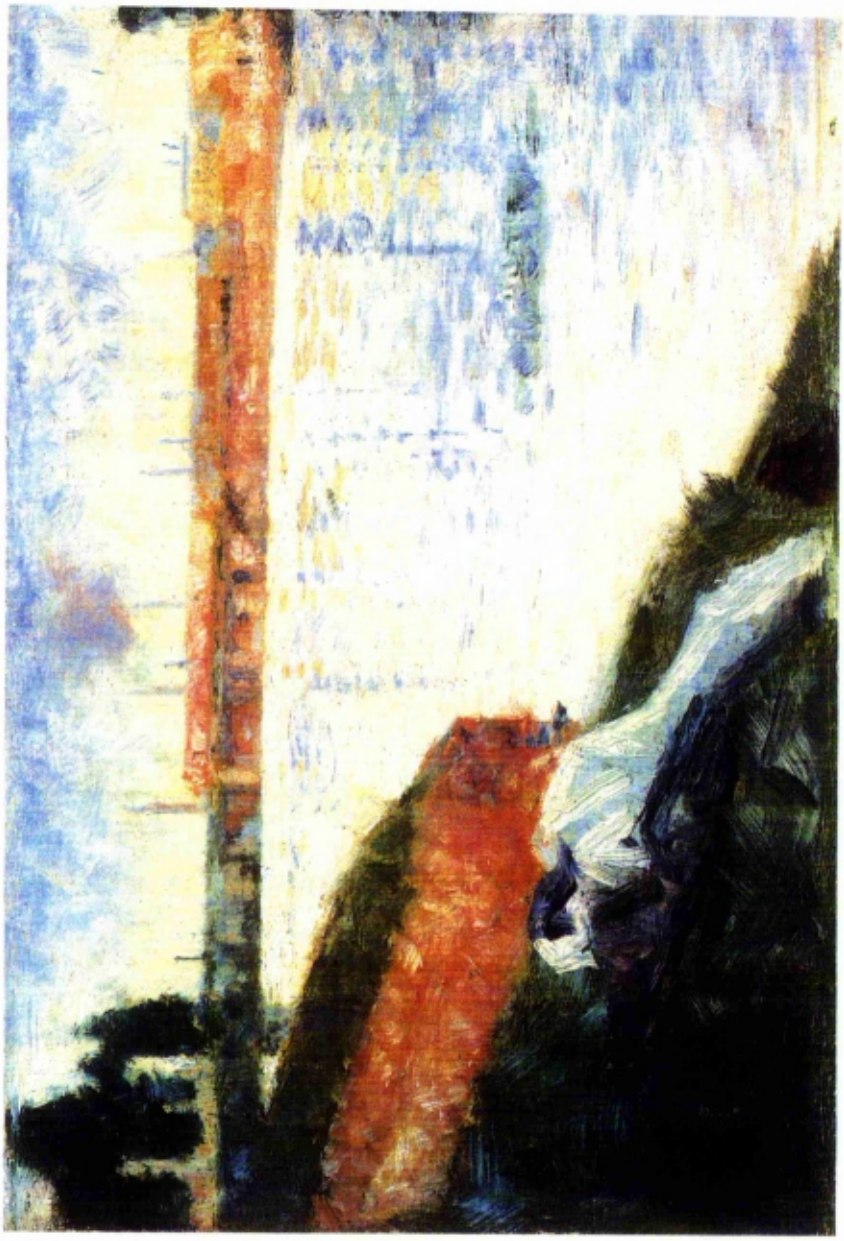
Le faucheur, 1881-2 **AND** Paysannes au travail, 1882-83

25
L'arc-en-ciel, 1883

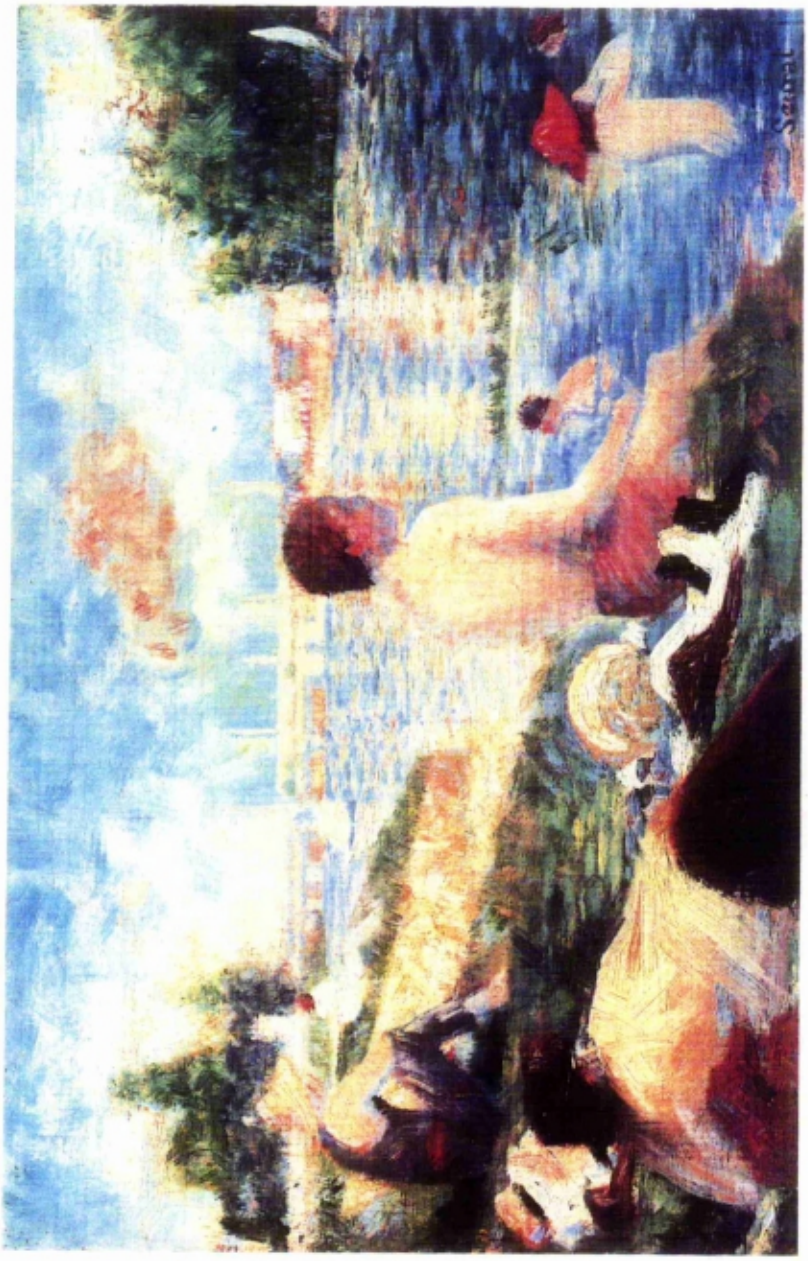


26
Chevaux dans l'eau, c. 1883

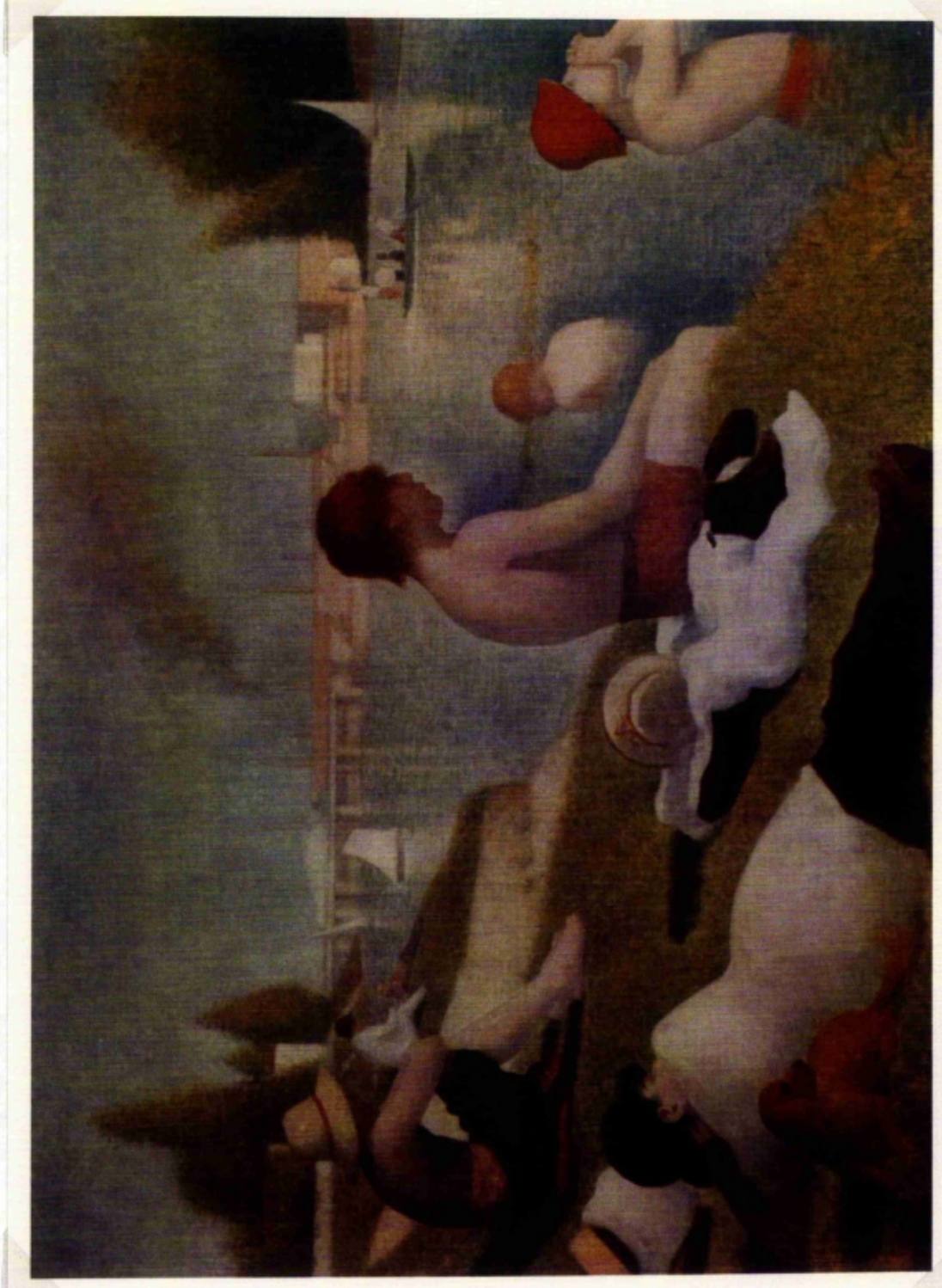
27
Vêtements sur l'herbe, 1883



Final study, Bathers at Asnieres



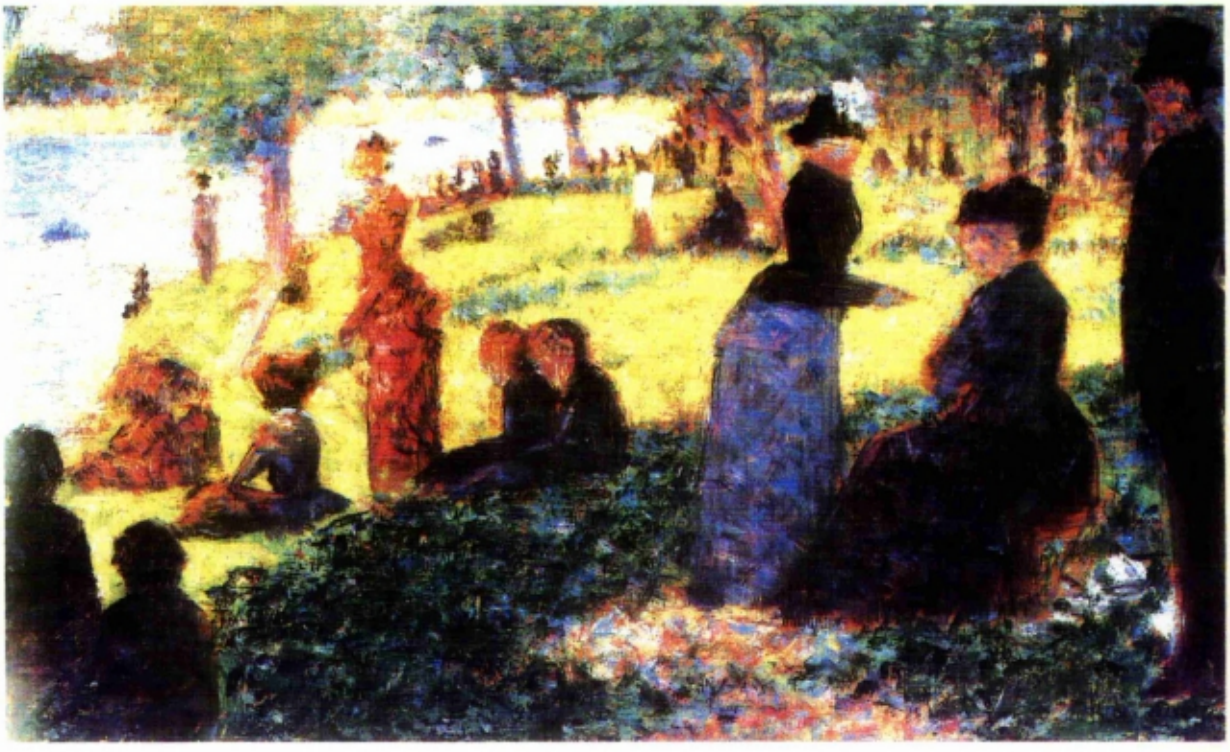
29
Une Baignade, 1883



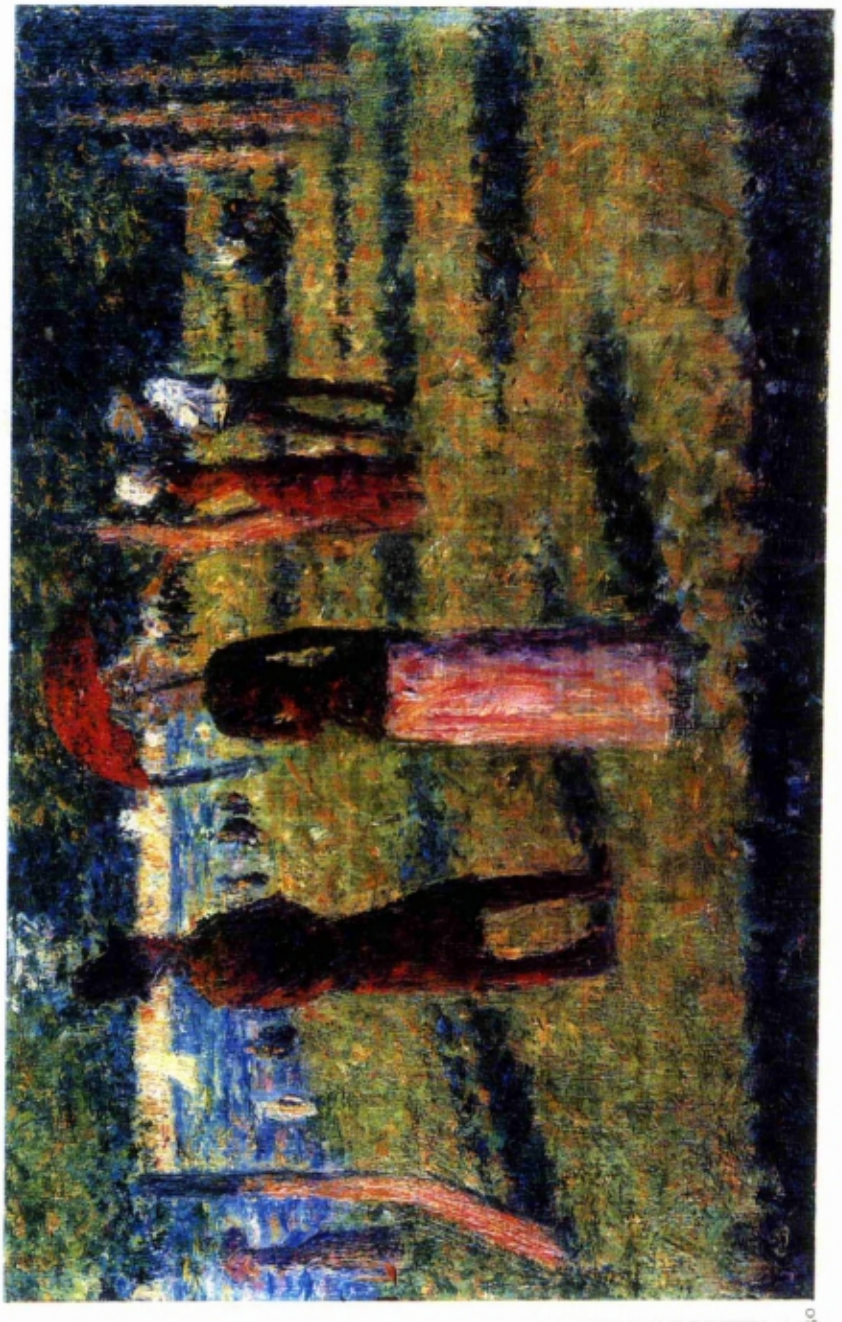
Red hat detail of Bathers at Ansieres

31
La Grande Jatte, final study
Changing colours from two different reproductions

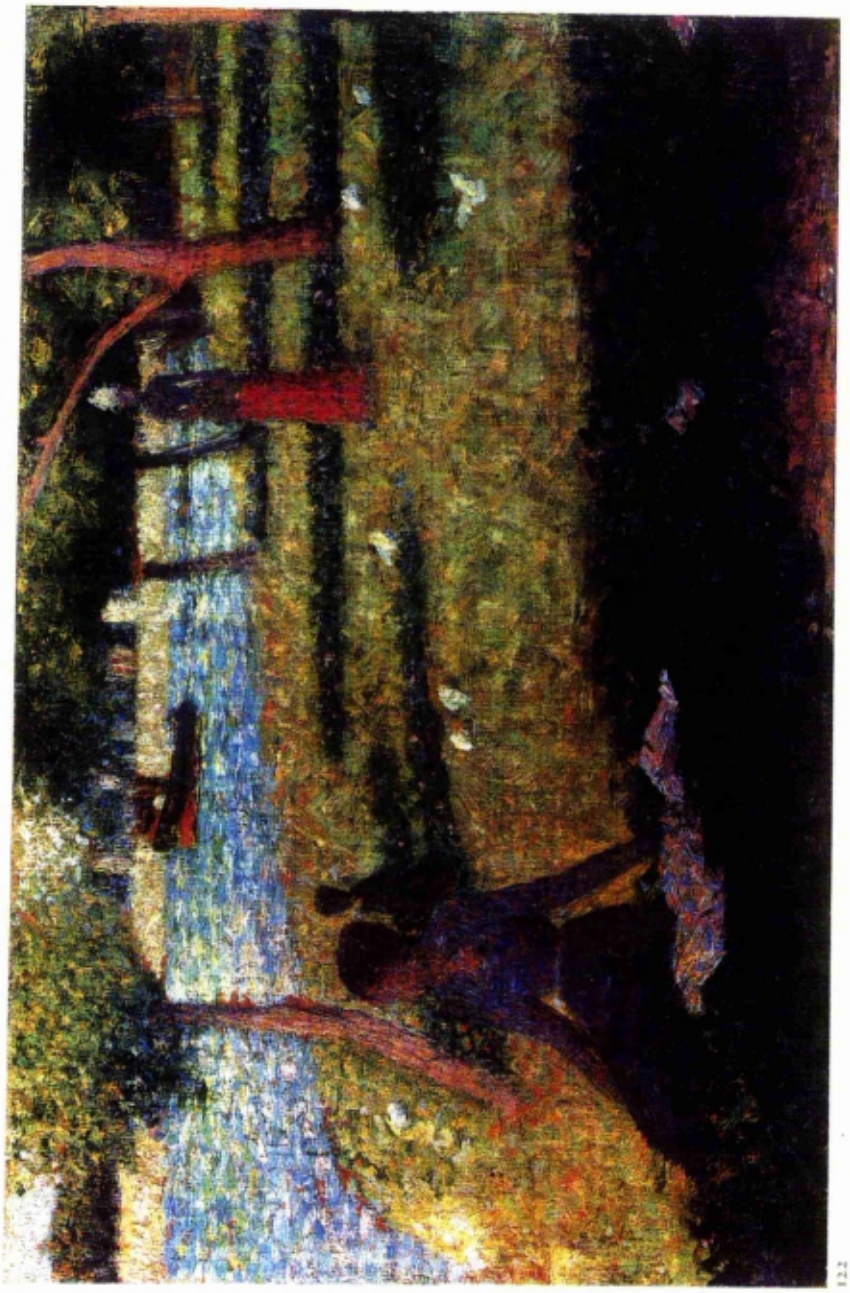
Massive dans un Paysage `a Barbizon, c. 1882
AND Petite equisse pour "LGJ", 1884-1885
Showing a re-use of key figures



33
La jupe rose, 1884

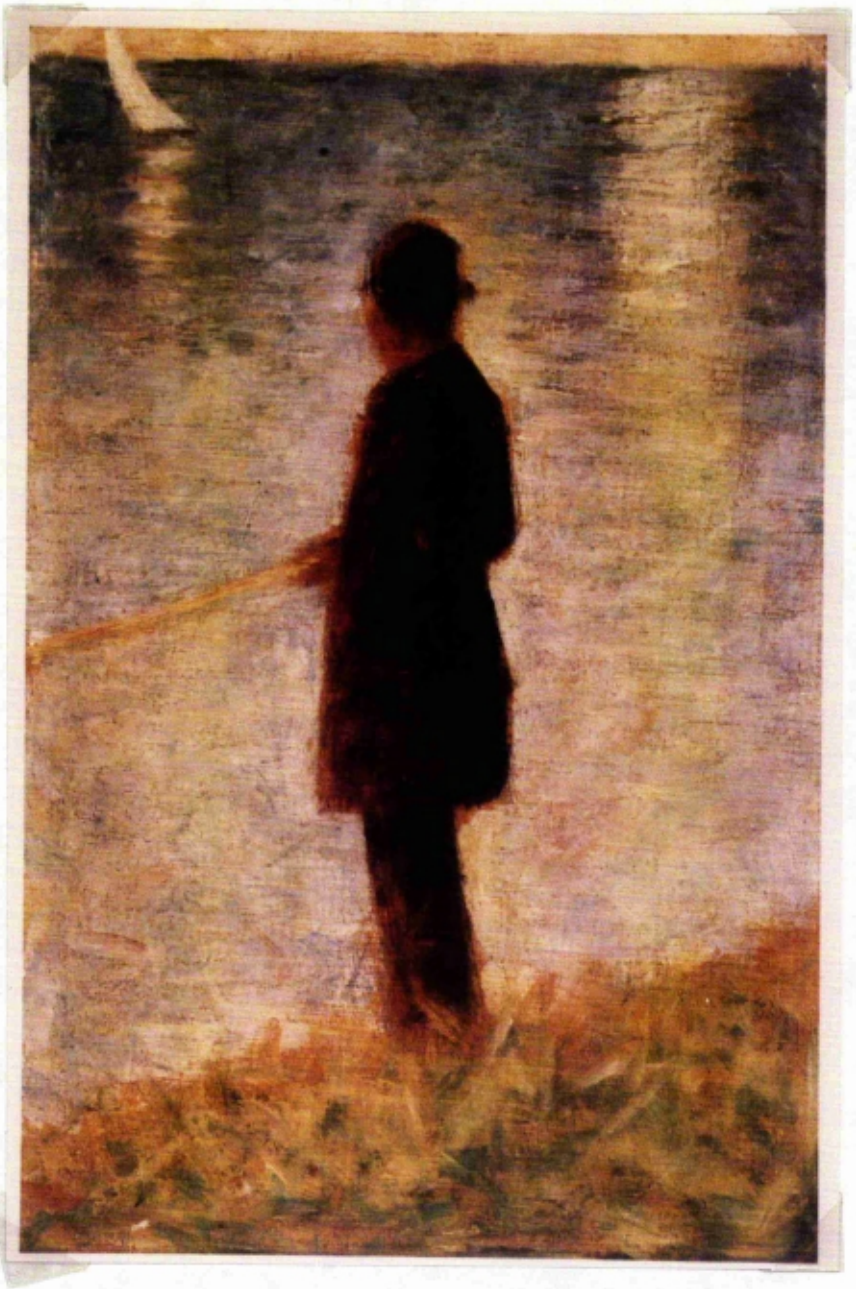


34
Paysage et personnages, 1884

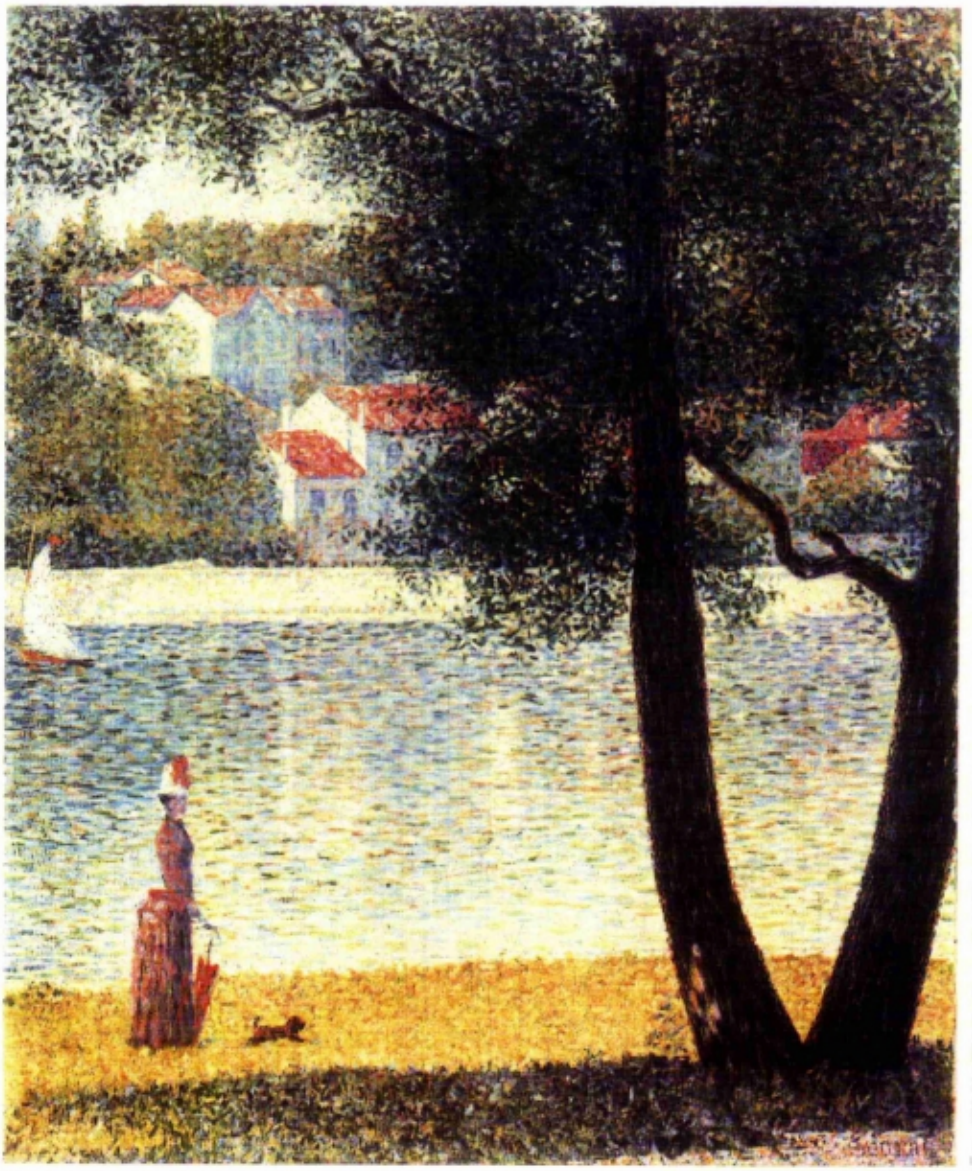


35
Le Couple, 1884

36
The Angler, c.1884



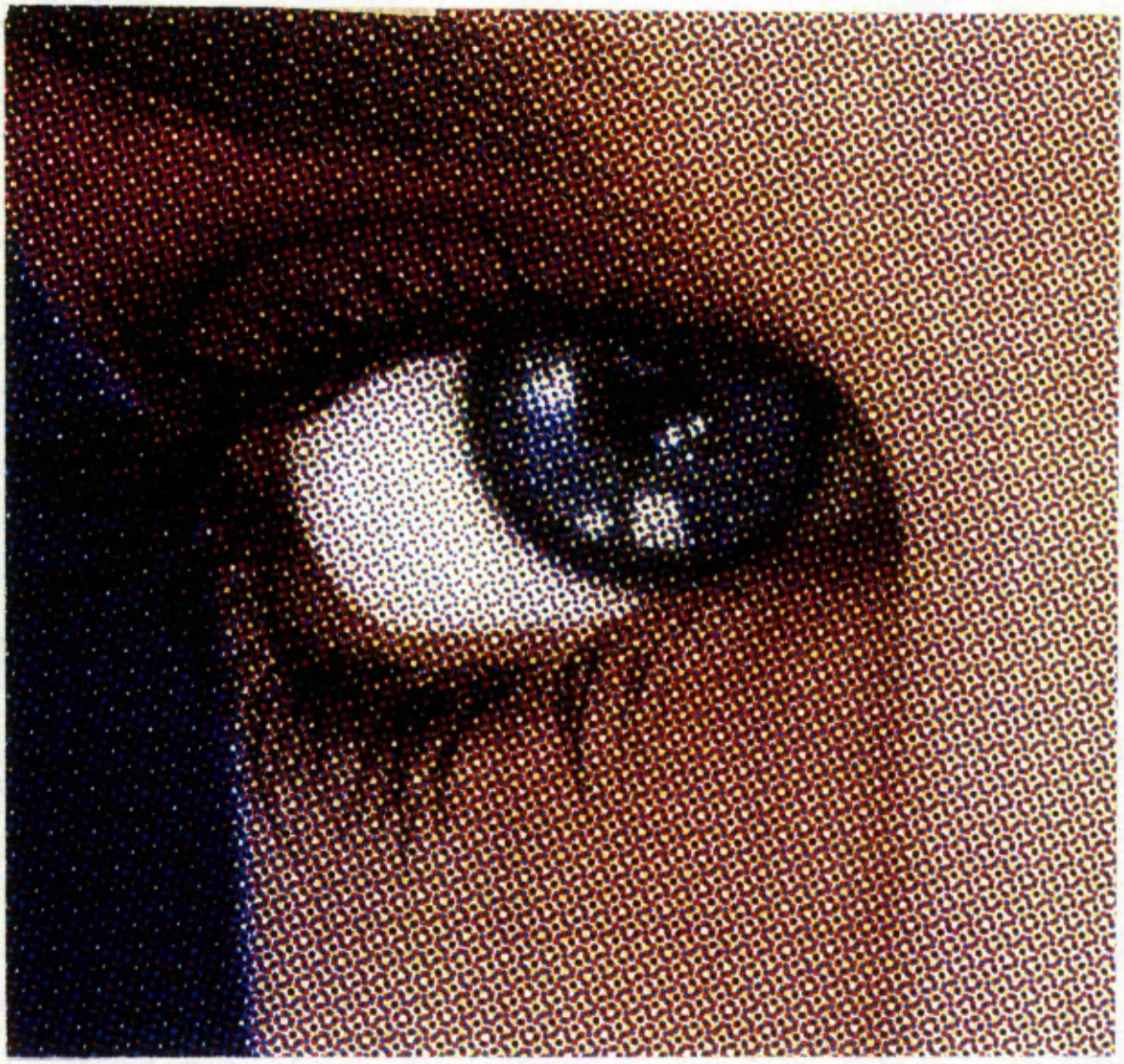
37
Le Seine`a Courbevoie, 1885




A
B
C
D
E
My areas for study
Inge Fiellers areas for analysis

Enlargement D, plume on hat **AND** sm. photo of same

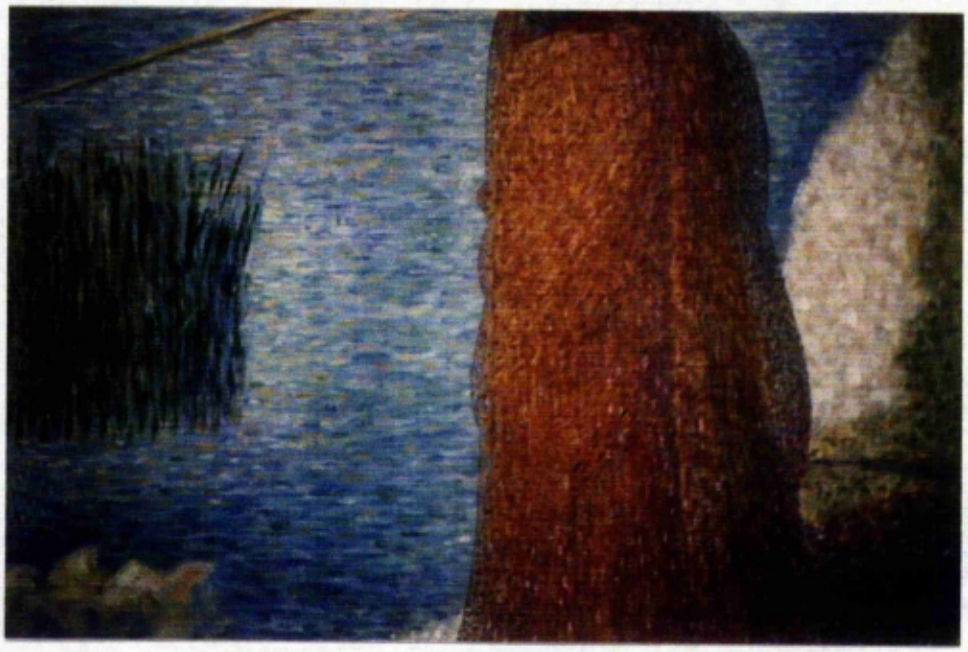
40
Colour "print" of lady's eye



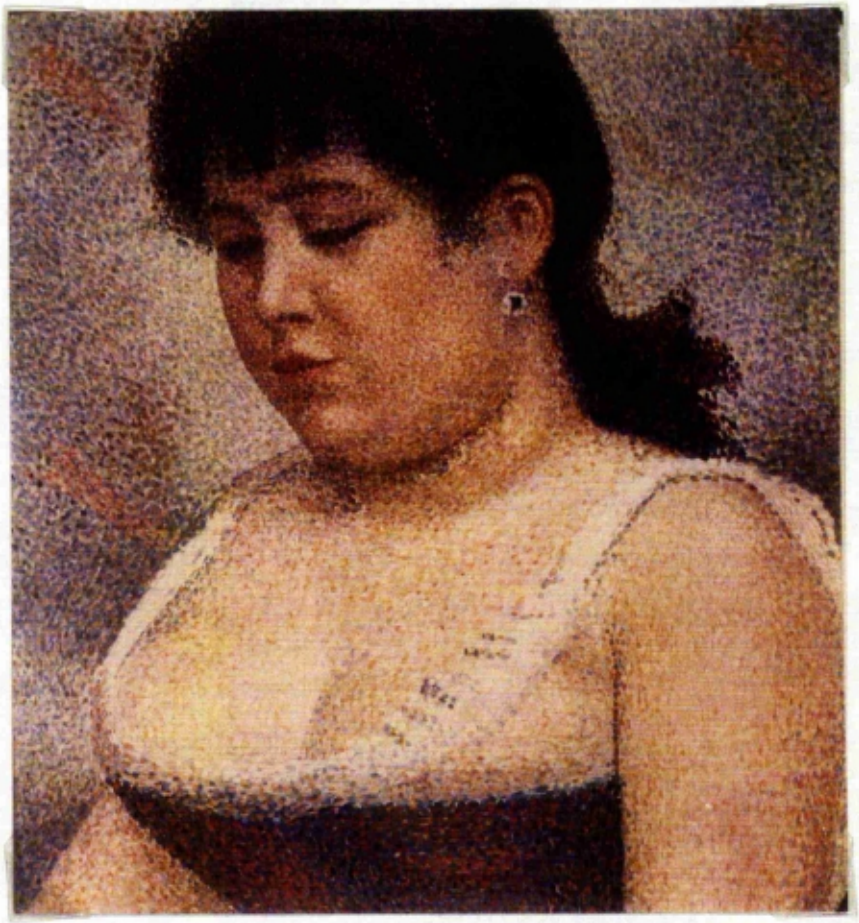
The colours combinations in La Grande Jatte correspond to those suggested by Rood on his contrast diagram and not to those suggested by Chevreul or Blanc

Drawing of RHS of La Grande Jatte

Enlargement B, fisherwoman's skirt **AND** sm. photo of same

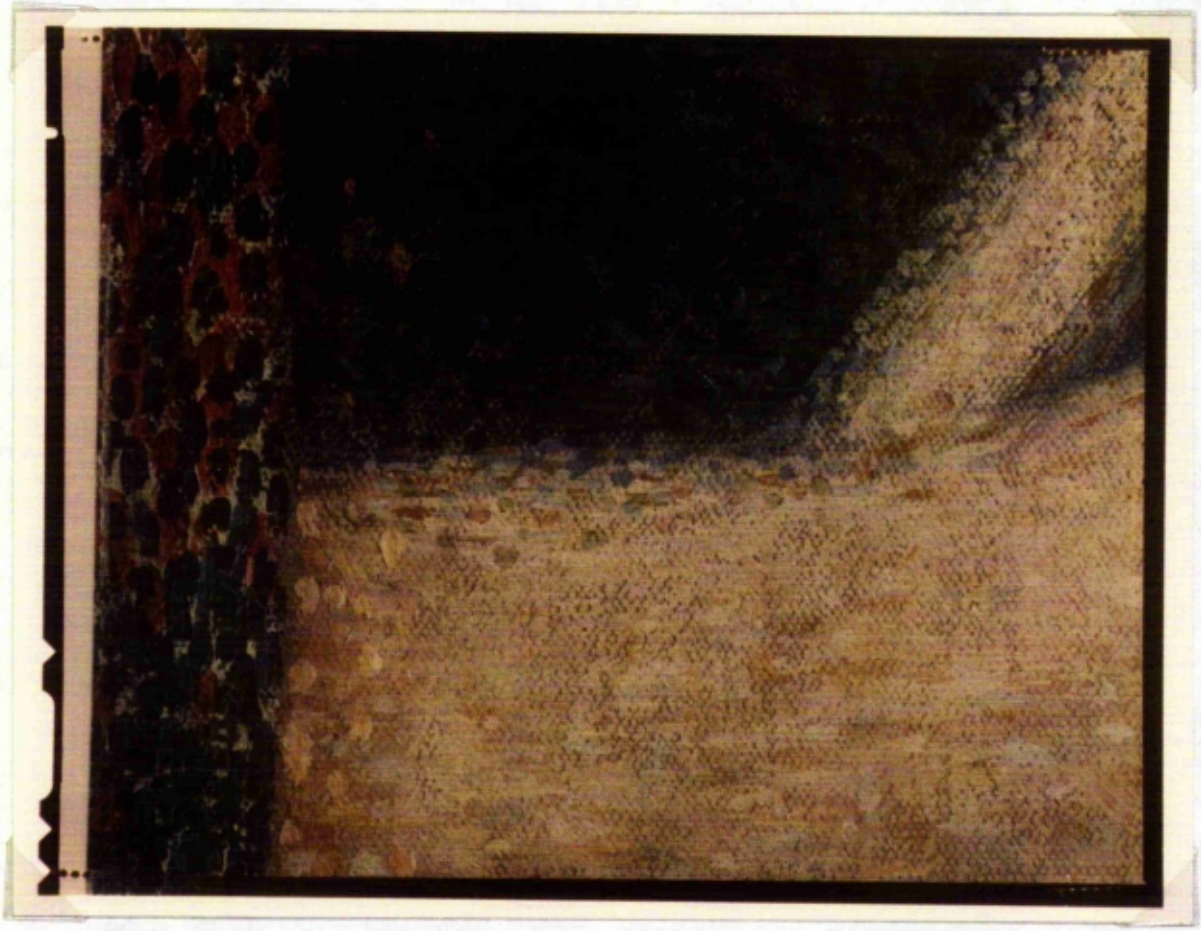


Detail Jeune femme se poudrant, c. 1888-1890

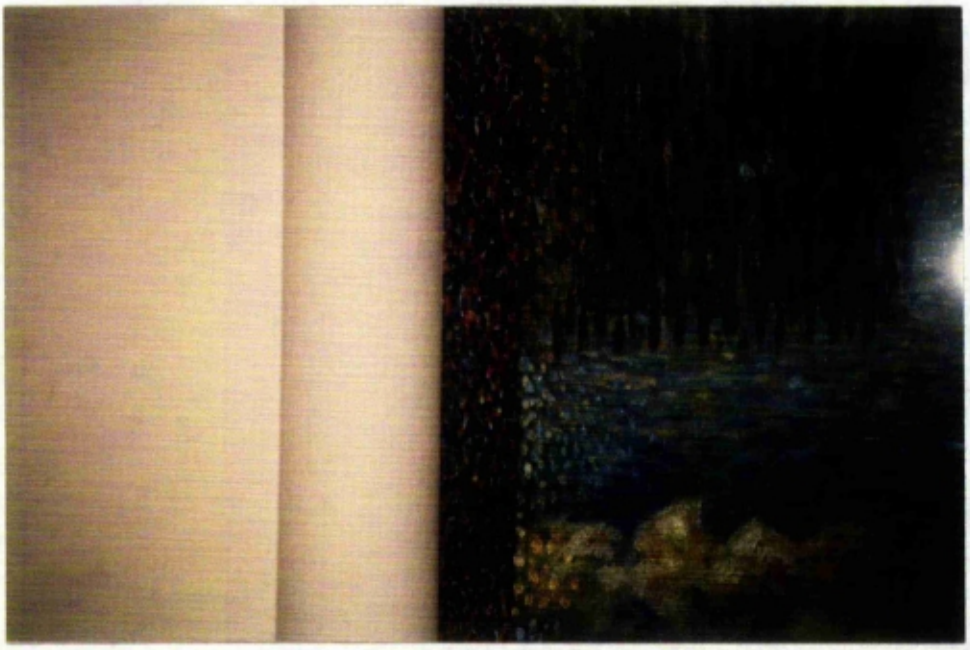


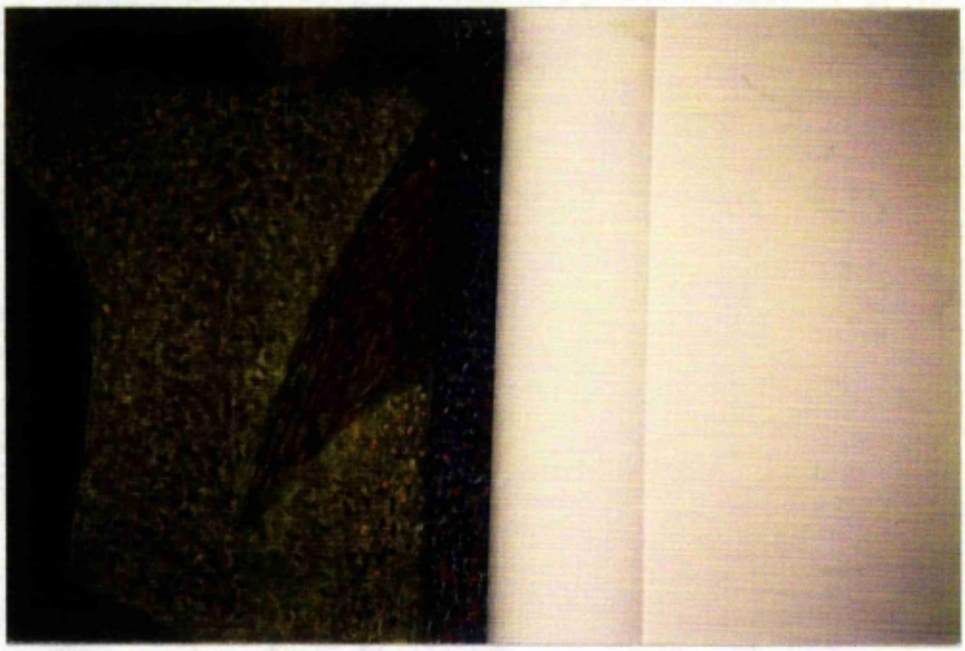
Enlargement A, section of tree **AND** sm. photo of same

Enlargement E, workman's trouser leg and painted border



47a
Section La Grande Jatte, painted border---left hand side
47b
Section La Grande Jatte, painted border--right hand side





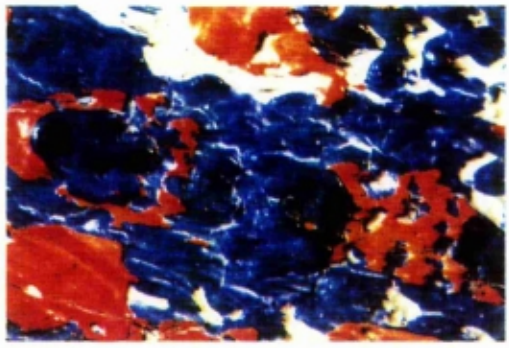
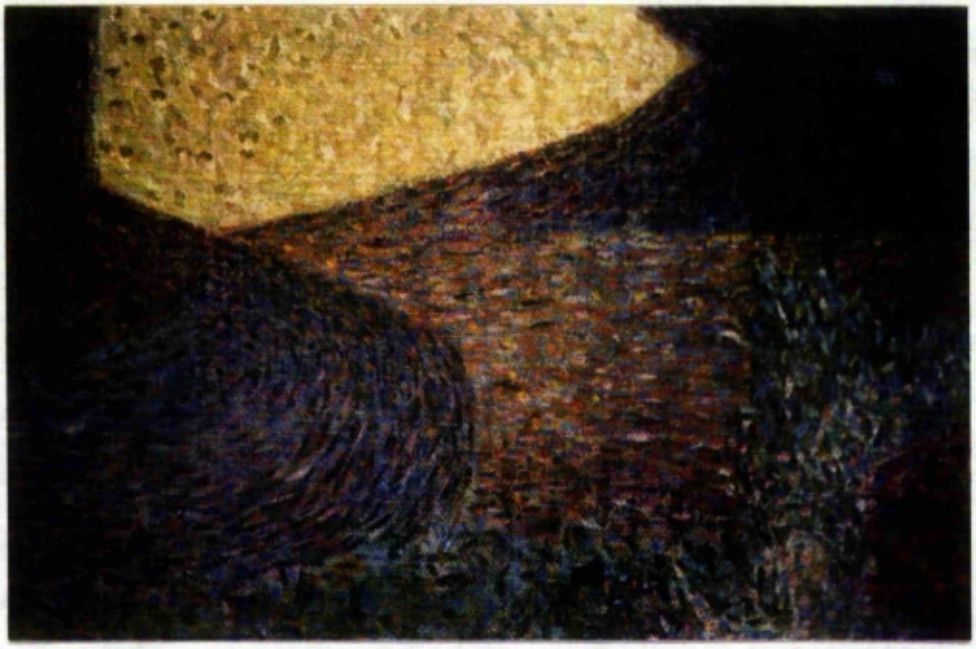


PLATE 13. Seurat applied large, elongated dots and dashes in the borders; these are typical of his brushwork in 1889–90. This is a photomicrograph of the border (see p. 174, fig. 1) magnified 7 times. The larger strokes, running parallel to the picture's edge, are covered occasionally by smaller, rounded dots.

PLATE 14. Most sections adjacent to the border, as seen in plates 6 and 12, have a parallel series of large dots that echo the line of the border in the painting. The majority of these dots are orange or yellow, though a fraction, as here, are blue and green. The dots are simple mixtures. This area, magnified 11 times, shows an orange dot consisting of brushmarks of chrome yellow and vermilion combined with lead white; parts of a blue and green dot in the band are also visible.

Solar orange?

Enlargement C, skirts of seated girls **AND** sm. photo of same



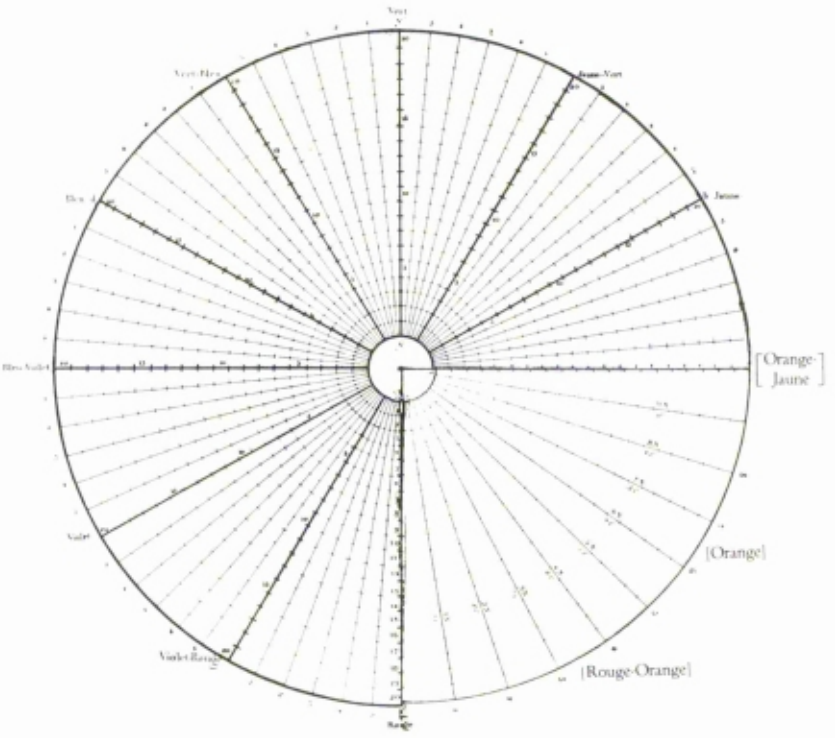


Figure 7. Chromatic Circle (from M.-E. Chevreul, *De la loi du contraste simultané des couleurs*).

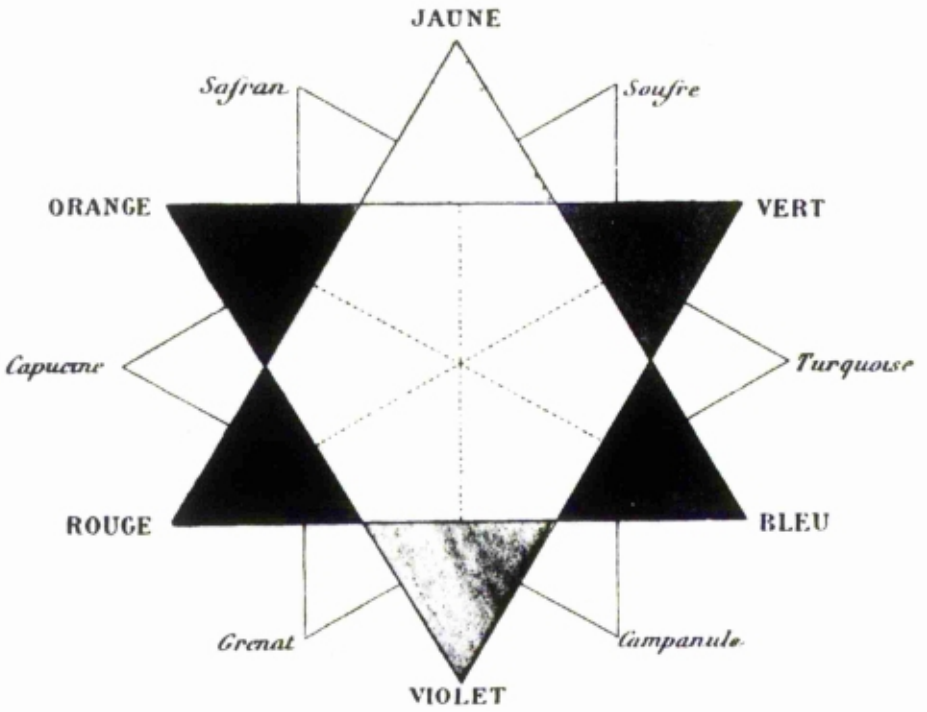
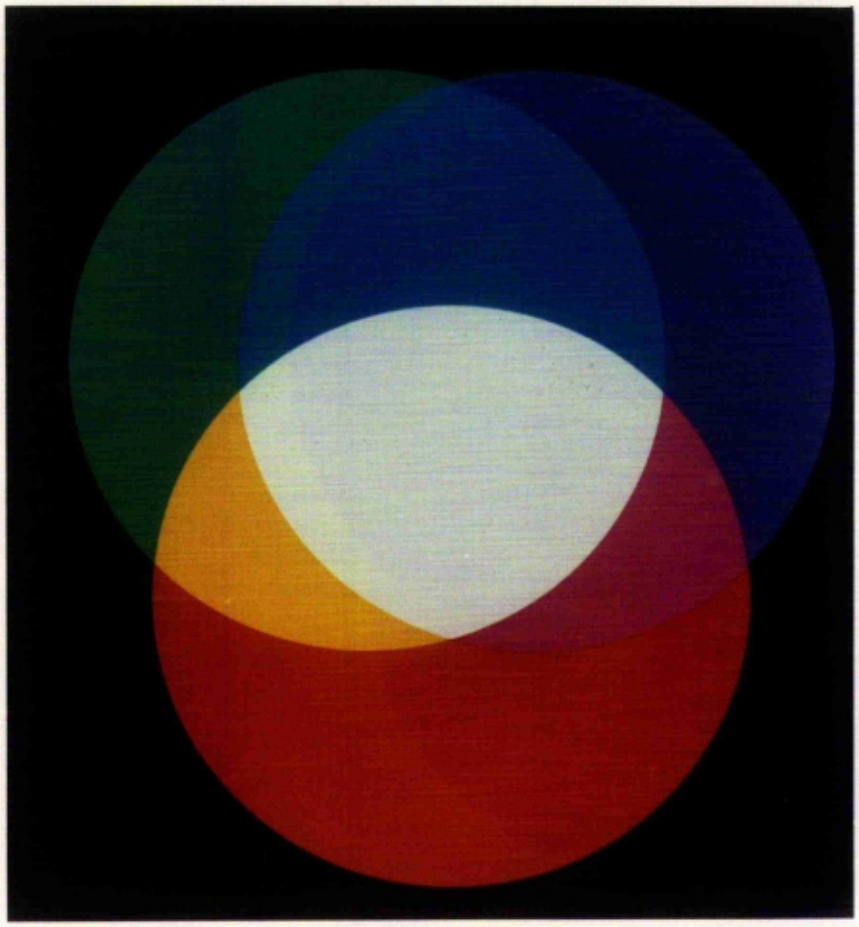
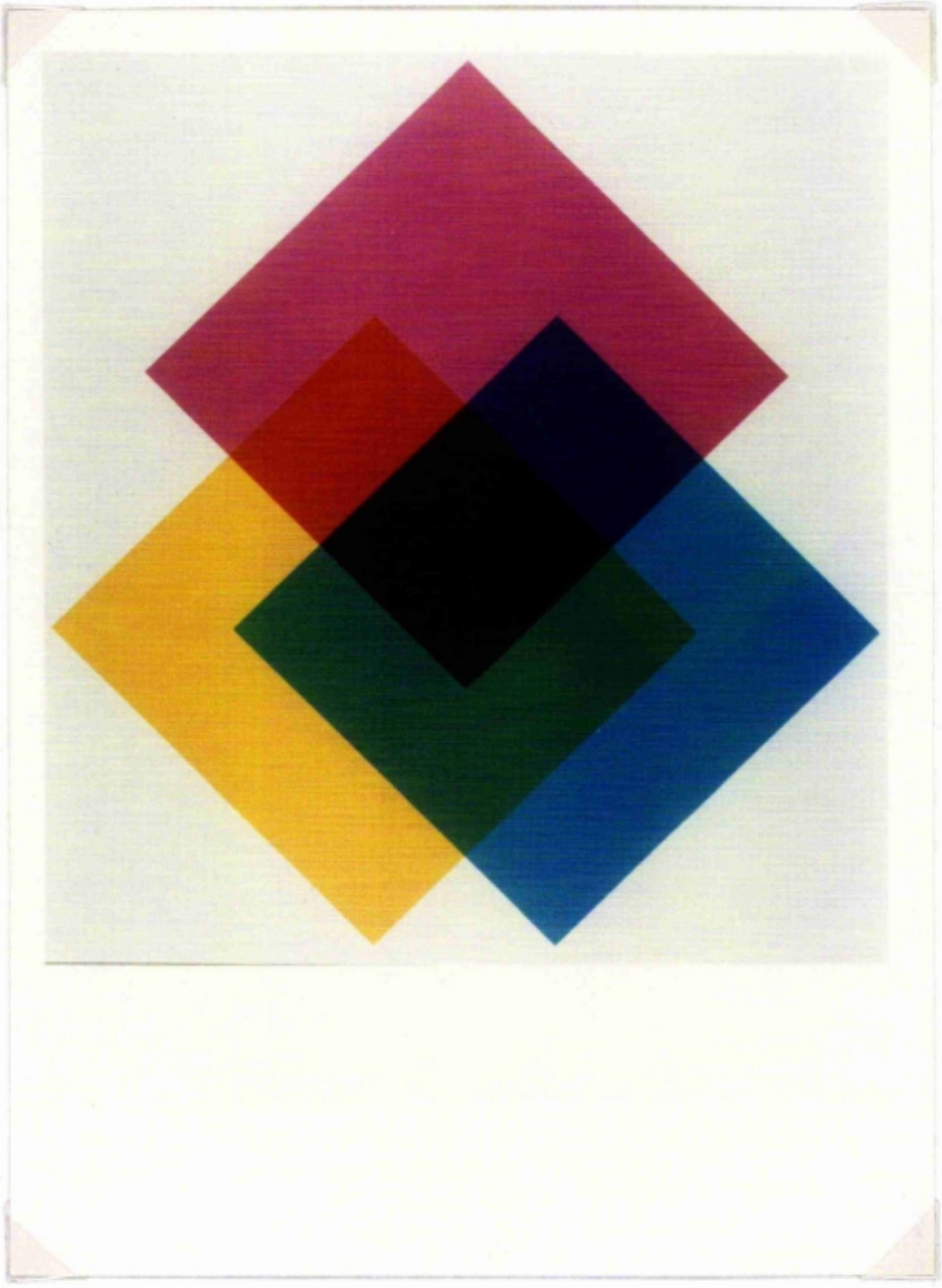
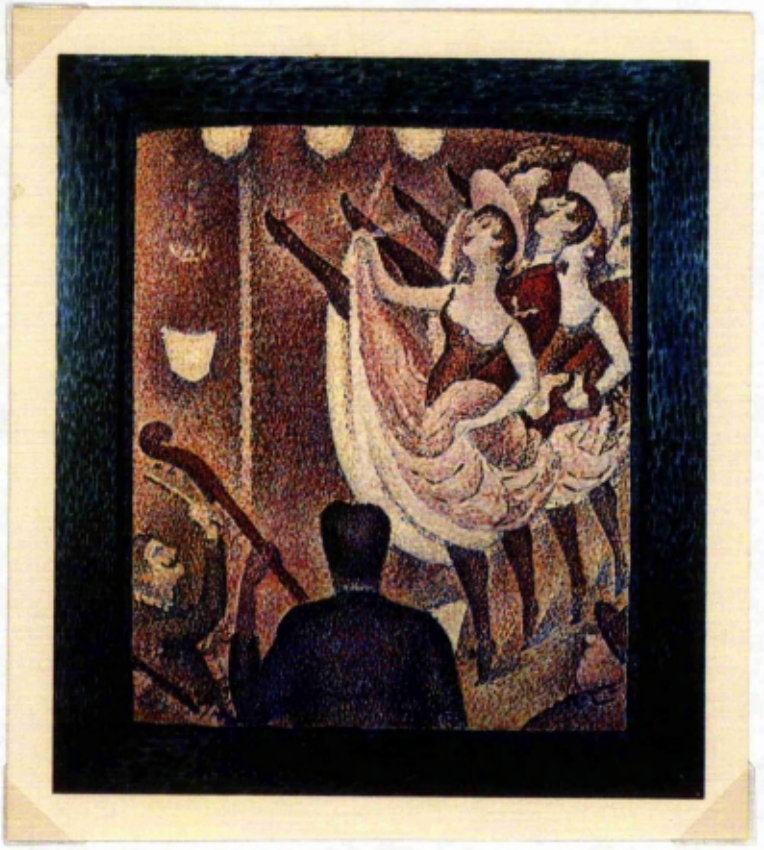


Figure 9. Chromatic Diagram (from Charles Blanc, *Grammaire des arts du dessin*).



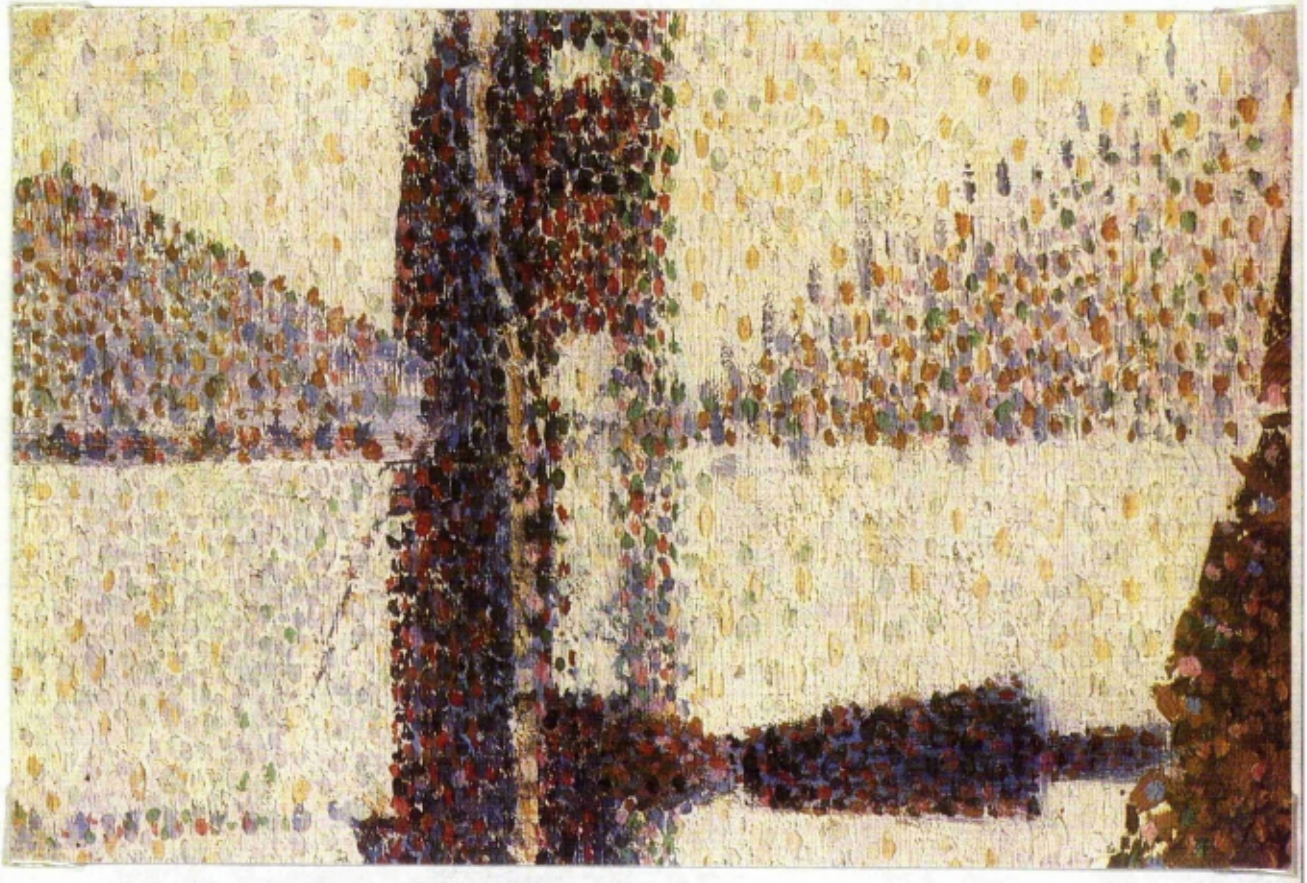


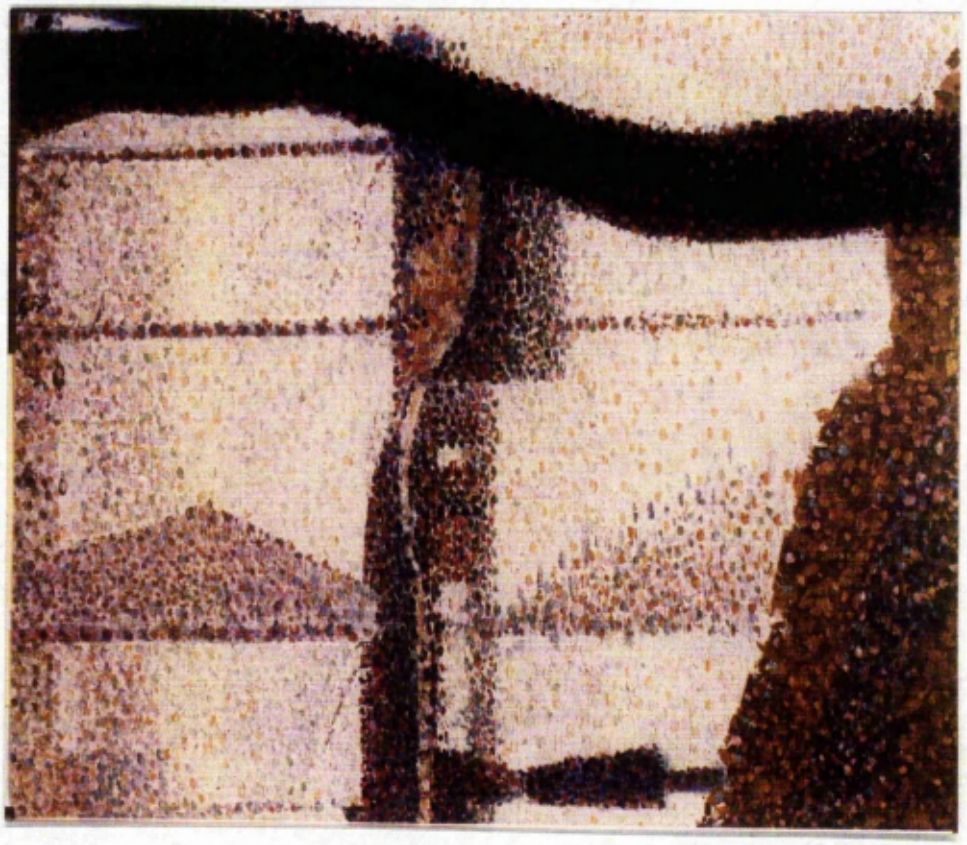


54a
Le Chahut, 1889-1890
54b
Final study Le Chahut

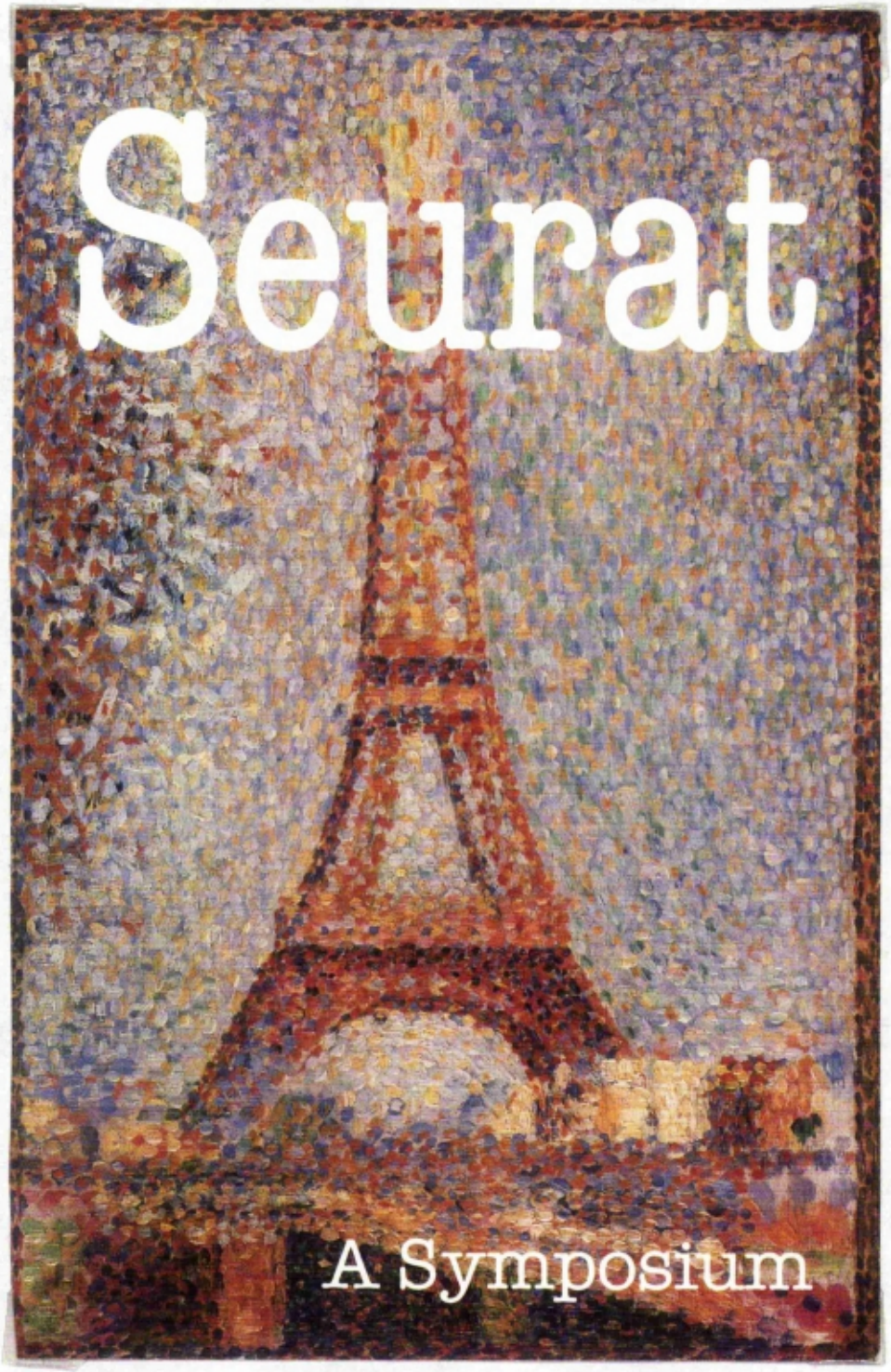
55
Bridge at Courbevoie, 1886-1887

56a
Section of Bridge at Courbevoie, tree
56b
Section of Bridge at Courbevoie, man and water

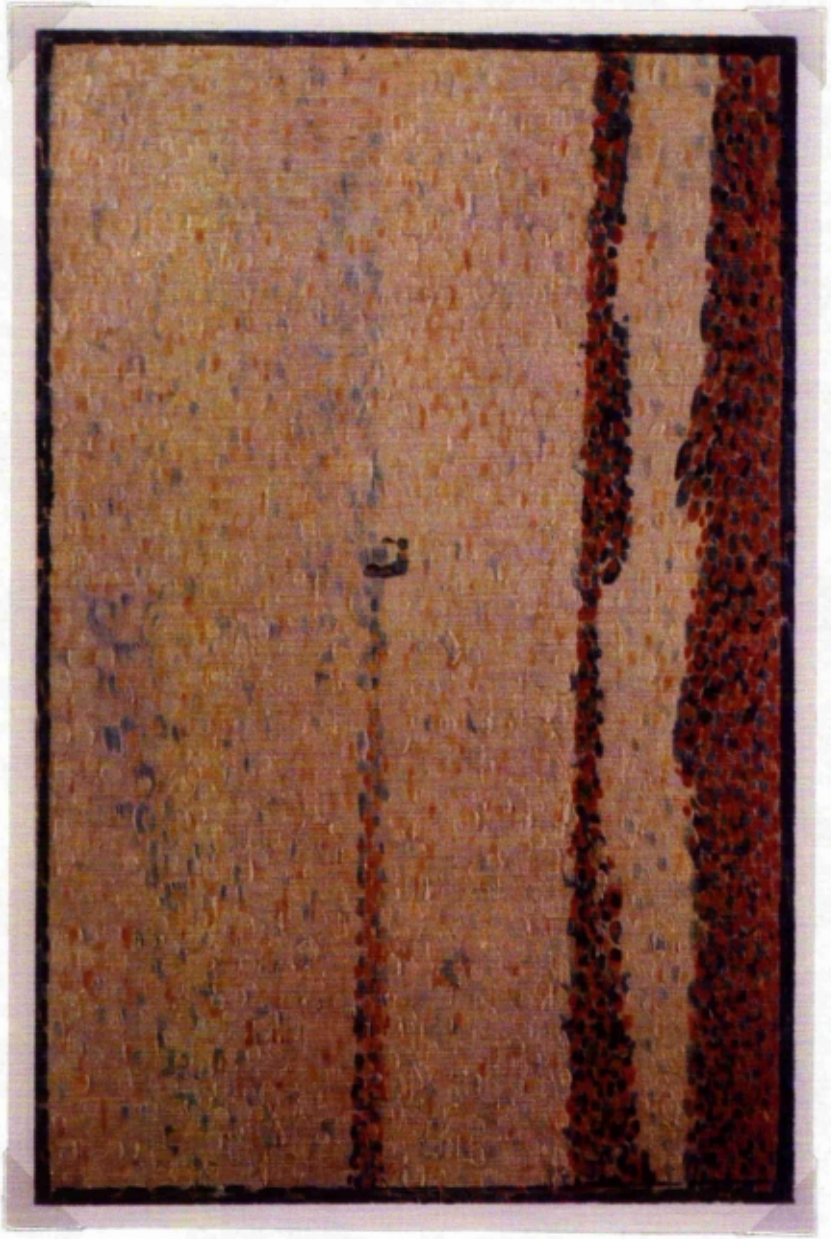




57a
Le Tour Eiffel, 1889



57b
Beach at Gravelines, 1890



B/W version of Jeune femme se poudrant

Jeudi 28 Août

Mon cher Monsieur Maurice Beaubourg.

Permettez-moi de vous remercier et de vous dire combien je suis touché par votre aimable lettre.

Dubois-Pillet le fondateur de la société des artistes indépendants était un cœur loyal une nature droite que nous regretterons. Il était doublé d'un chercheur comme vous pouvez le voir dans le N° 370 des hommes d'aujourd'hui. Vanier éd. texte de Jules Christophe

Je connaissais moins intimement Van Gogh. En 1887 je lui parlais pour la première fois dans un bouillon populaire situé près de la fourche avenue de Clichy. (fermé) Un immense hall vitré était décoré par ses toiles. Il exposa aux indépendants de 1888. 1889. 1890.

Signac m'a appris sa mort ainsi : « Il se flanque une balle dans le côté, elle traverse le corps et va se loger dans l'aine. Il se promène deux kilomètres, perdant tout son sang et va expirer à son auberge. »

Voici les titres de mes grandes toiles.

Baignade (Asnières) 2 mètres / 3 mètres — ex. indépendants (groupe) 15 mai 1884 — New York 1885.

Études pour un dimanche à la grande Jatte. Indépendants (société) décembre 1884

Un dimanche à la grande Jatte 1884 — 2 mètres / 3 mètres — Indépendants Août 1886 — Impressionnistes Mai 1886 — Bruxelles Février 1887

Études à la gde Jatte et à Honfleur à Grandcamp

Indépendants de 1887 études faites à Honfleur – Petite Poseuse.

Indépendants 1888 ~~Lo~~ Poseuses 2 mètres / 2 m. 50 — Bruxelles 1889 id. — Dessins

Indépendants 1889 études faites au Crotoy

Indépendants 1890 Chahut 1 m. 50 / 2 m. études grande Jatte Port en Bessin

Une notice bibliographique les hommes d'aujourd'hui me concerne
N° 368 texte de Jules Christophe
Le N° 373 de Félix Fénéon est pour Signac le 376 pour Luce
(Jules Christophe)
Les grandes toiles de Signac sont:
~~Les Modistes~~ Apprêteuse et garnisseuse (modes) rue de Caire 85 86
La salle à Manger 87 Un Dimanche à Paris 89.90
Mais la notice que vous pourrez facilement vous procurer
vous renseignera mieux que je ne puis le faire.
Vous y trouverez la technique du mélange optique
parfaitement décrite au point de vue scientifique
Pour finir je vais vous dire la note esthétique et technique
qui termine le travail de M. Christophe et qui vient de moi
je la modifie un peu n'ayant pas été bien compris par l'imprimeur

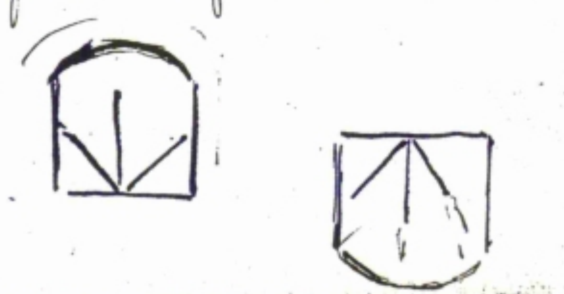
Esthétique:
L'Art c'est l'Harmonie
L'Harmonie c'est l'analogie des contraires. l'analogie des semblables
de ton de teinte de ligne considérés par la dominante
et sous l'influence d'un éclairage en combinaisons
gaies ~~calmes~~ ~~ou~~ tristes

Les contraires ce sont:
p.: le ton un plus (lumineux / clair) p. un plus sombre
pour la teinte les complémentaires. c.a.d. un certain rouge opposé à sa complémentaire etc..
Rouge – Vert
Orangé – Bleu
Jaune – Violet
pour la ligne celles faisant un angle droit

La gaité de ton c'est la dominante lumineuse de teinte la dominante chaude de ligne, les lignes au dessus de l'horizontale
Le calme de ton c'est l'égalité du sombre et du clair de teinte du chaud et du froid et l'Horizontale pour la ligne
Le triste de ton c'est la dominante sombre de teinte la dominante froide et de ligne les directions abaissées

Technique
Étant admis ~~que~~ les phénomènes de la durée de l'impression lumineuse sur la rétine ~~sont les mêmes~~
~~Le moyen d'expression sera synthétique~~
La synthèse s'impose comme résultante
Le moyen d'expression est le Mélange optique des tons des teintes (de localités et de la couleur éclairante soleil lampe à pétrole gaz etc) c'est à dire des lumières et de leurs réactions (ombres) suivant les lois du contraste de la dégradation de l'irradiation.

Le cadre ~~n'est plus comme au commencement~~ est ~~dans l'~~ harmonie opposée à celle des tons des teintes et des lignes du ~~motif~~ tableau



Appendix E

Seurat's *Esthétique*

In 1890, in response to an inquiry from the journalist Maurice Beaubourg, Seurat prepared several drafts of a letter outlining his theories, but he never sent it.[1] The letter consists of two parts, an autobiographical introduction and a formal statement of his theories. There is a separate draft (de Hauke archives) of the autobiographical introduction, in which there is this important sentence: "I committed myself to four large canvases *of combat* if you permit me to speak that way" ("J'ai commis 4 grandes toiles *de lutte* si vous voulez bien me permettre de parler ainsi"). Seurat named only two, using initials, B[aignade] and D[imanche à la Grande Jatte]. Following the word "ainsi," he wrote and then crossed out: "and I prefer them to all my landscape studies" ("et je les préfère à toutes mes études de paysage").

Of the *esthétique*, the key portion of the letter, there are four drafts. Only the fourth is printed here in its entirety; some punctuation and paragraphing have been added to ensure clarity. Words that Seurat crossed out appear in square brackets. "Ton" and "teinte" have been translated by their nineteenth-century equivalents, "tone" and "tint," although today many would say "value" and "hue" (the latter, however, is not the same as "tint," which incorporates the idea of a degree of saturation, as distinct from pure hue).

Version A

Signac archives. This is probably the first, and certainly the most complicated, of the drafts, with many words inserted and others crossed out. It is headed with a statement of great importance, later used by Signac and John Rewald to describe Seurat's ideas:

> [chart] general practical theory grounded on Delacroix and oriental precepts, supported by the experiments of Chevreul, Rood, Helmholtz, C. Henry [and the Oriental tradition]
>
> [tableau] théorie pratique générale partant de Delacroix et de préceptes orientaux, s'appuyant sur les expériences de Chevreul, Rood, Helmholtz, C. Henry [et la tradition orientale]

Chevreul, Rood, and Henry are discussed separately in this catalogue. It is likely that Seurat's knowledge of Helmholtz was limited to what he learned from Rood, who made clear the German scientist's seminal role in color theory (he had vindicated Thomas Young's theory of three retinal color receptors). The "Oriental precepts" and the "Oriental tradition" may refer to Gauguin's copy of a text supposedly by a Turkish artist (see Appendix P), but they probably also reflect the widespread notion that Asians had a special genius for color.

The most surprising feature of this and the next two versions is that Seurat did not know how to incorporate Charles Henry's ideas about linear proportion. In Version D, the only one known until now, he wrote of the expression of gaiety, calmness, and sadness in terms of tone, tint, and line. In writing of "line" in Version A, he substituted or added "silhouette," "direction," "form," and "modeling," and even more confusingly, for sadness of line he wrote "of curving form" (crossed out) and "curve" ("de forme courbe" and "courbe").

Version B

De Hauke archives. This is a much shorter text than Versions A and D, with four rather than three terms by which gaiety, calmness, and sadness could be expressed. Included is this section:

> Gaiety of value is the *light* dominant.
> ———of color———*warm*———.
> ———of proportion———————dominant given to the gayest directions.
> ———of direction is the dominant given to the gayest lines, that is, to those raised above the horizontal.
>
> La gaité de valeur c'est la dominante *claire*
> ———de couleur———————*chaude*
> ———proportion———————donnée aux directions les plus gaies
> ———direction c'est la dominante donnée aux lignes les plus gaies, c.à. dire élévées sur l'horizontal

Version C

Signac archives. An equally short text, this version includes four terms of expression rather than three and is quite certainly derived from Henry. Included is this section:

Gaiety of tone is the luminous dominant.
of tint the warm dominant.
of proportion the dominant of measure given to the direction [gay] the most
of direction the dominant above the horizontal and to the right of the upright vertical

La gaité de ton c'est la dominante lumineuse
de teinte la dominante chaude
de proportion la dominante de mesure donnée à la direction [gai] la plus
de direction la dominante au dessus de l'horizontale et à droite de la verticale élevée

VERSION D

Private collection (cat. no. 231). First published by Fénéon ("De Seurat," 1914), this capital document was subsequently reproduced photographically in Rey 1931. In this version the fourth term found in the other versions is eliminated. Seurat was confused about the relative roles of "proportion" and "direction," so he limited himself to the term "line" in this final draft. In doing so, he reverted to the traditional conceptions of expression that can be found in Blanc, albeit with different terminology.

Thursday August 28

My dear Monsieur Maurice Beaubourg.
Permit me to thank you and to say how much I am touched by your kind letter.

Dubois-Pillet, the founder of the Société des Artistes Indépendants, was loyal-hearted, an upright nature whose loss we feel.[2] He was in addition a researcher, as you can see in No. 370 of *Les hommes d'aujourd'hui*, ed. by Vanier, text by Jules Christophe.

I knew van Gogh less intimately. I spoke to him for the first time in 1887 in a popular eatery near La Fourche, avenue de Clichy (closed). A huge windowed room was decorated with his canvases.[3] He exhibited at the Indépendants in 1888, 1889, 1890.

Signac told me of his death this way: "He gave himself a bullet in the ribs; it passed through his body and lodged in his groin. He walked for two kilometers, losing all his blood, and went on to die in his inn."

Here are the titles of my large canvases:
Bathing Place (Asnières) 2 meters / 3 meters. ex. Indépendants (group) May 15, 1884. New York 1885[4]

---

studies for A Sunday on the Grande Jatte. Indépendants (Society) December 1884

A Sunday on the Grande Jatte. 1884 3 meters / 2 meters.
Indépendants August 1886. Impressionists May 1886. Brussels February 1887.

studies at the Grande Jatte and at Honfleur at Grandcamp

Indépendants in 1887 studies done at Honfleur. Small Model.

Indépendants 1888 [The] Models. 2 meters / 2 m. 50. Drawings.
Brussels 1889 id.

Indépendants 1889 studies done at le Crotoy

Indépendants 1890 *Chahut* 1.m 50 / 2 m. Studies Grande Jatte. Port-en-Bessin

A bibliographic note: Les hommes d'aujourd'hui concerns me, No. 368, text by Jules Christophe.

No. 373 by Félix Fénéon is on Signac. No. 376 on Luce (Jules Christophe).

Signac's large canvases are:

[The Milliners] Preparer and Fitter (fashion), rue du Caire 85–86. The Dining Room 87. A Sunday in Paris 89–90.

But the article that you can easily obtain will inform you better than I can.

You will find there the technique of *optical mixture* perfectly described from the scientific point of view.

In conclusion I am going to give you the aesthetic and technical note that concludes Mr. Christophe's piece and which originated with me: I am modifying it a little, not having been well understood by the printer.

Aesthetic:
Art is Harmony.
Harmony is the analogy of opposites, the analogy of similarities *of tone, of tint, of line* taking account of a dominant and under the influence of the lighting, in combinations that are
gay calm or sad

Opposites are:

for tone, a more luminous/lighter one for a darker one.

for tint, the complementaries, that is, a certain red opposed to its complementary, etc.

Red — Green
Orange — Blue
Yellow — Violet

for line, those making a right angle.

Gaiety of tone is the luminous dominant, *of tint*, the warm dominant, *of line*, lines above the horizontal.

Calmness of tone is the equality of dark and light; of tint, of warm and cool, and the horizontal for line.

Sadness of tone is the dark dominant; of tint, the cool dominant, and of line, downward directions.

Technique
Given the phenomenon [that] of the duration of the luminous impression on the retina [are the same],
[The means of expression will be synthetic.]
Synthesis is logically the result.

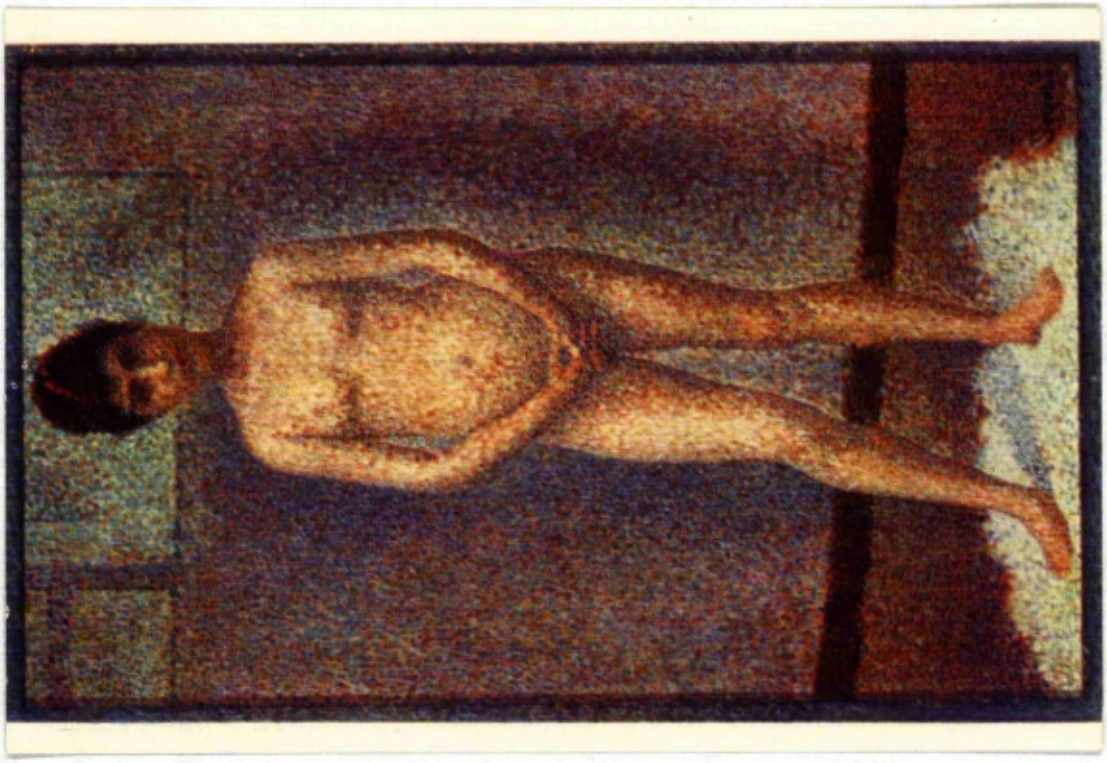
The means of expression is the optical mixture of tones, of tints (of local color and the illuminating color: sun, oil lamp, gas, etc.), that is, of the lights and of their reactions (shadows) following the laws *of contrast*, of gradation, of irradiation.

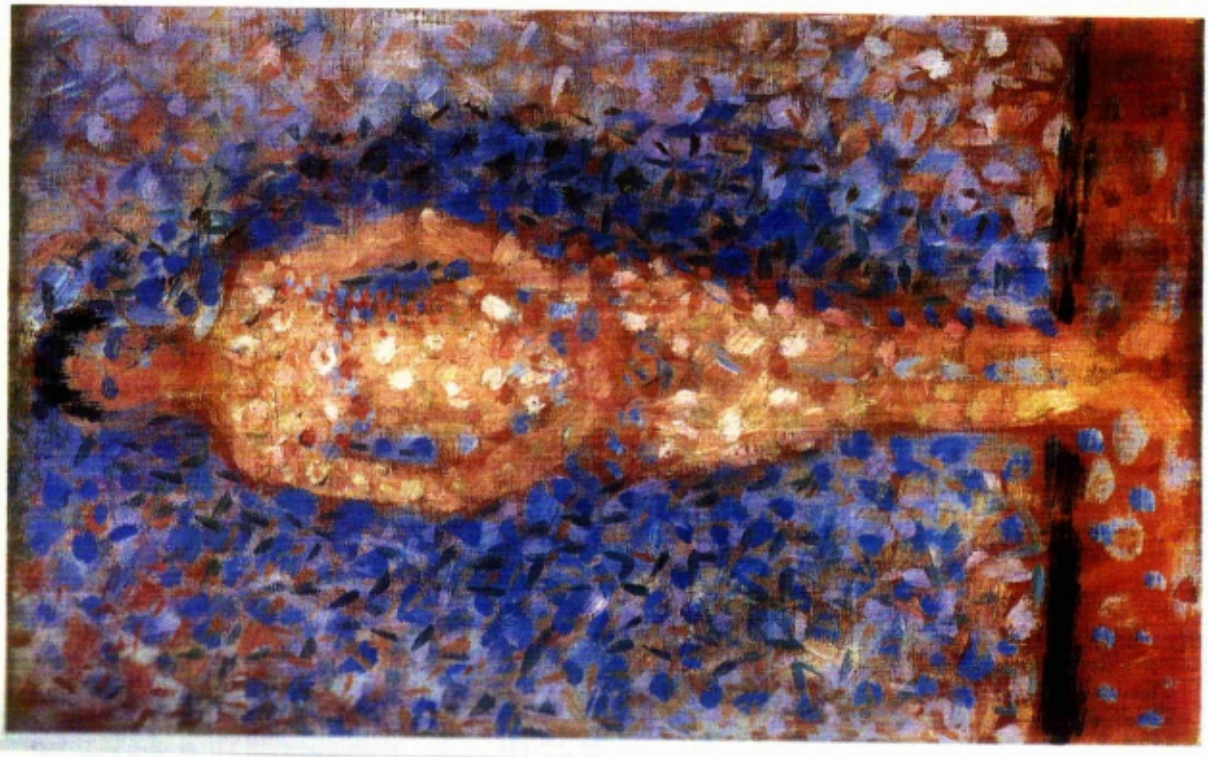
The frame [is no longer as in the beginning] is in a harmony opposed to those of the tones, tints, and lines of the [motif] picture.

60a
Section La Parade, smeary cravat

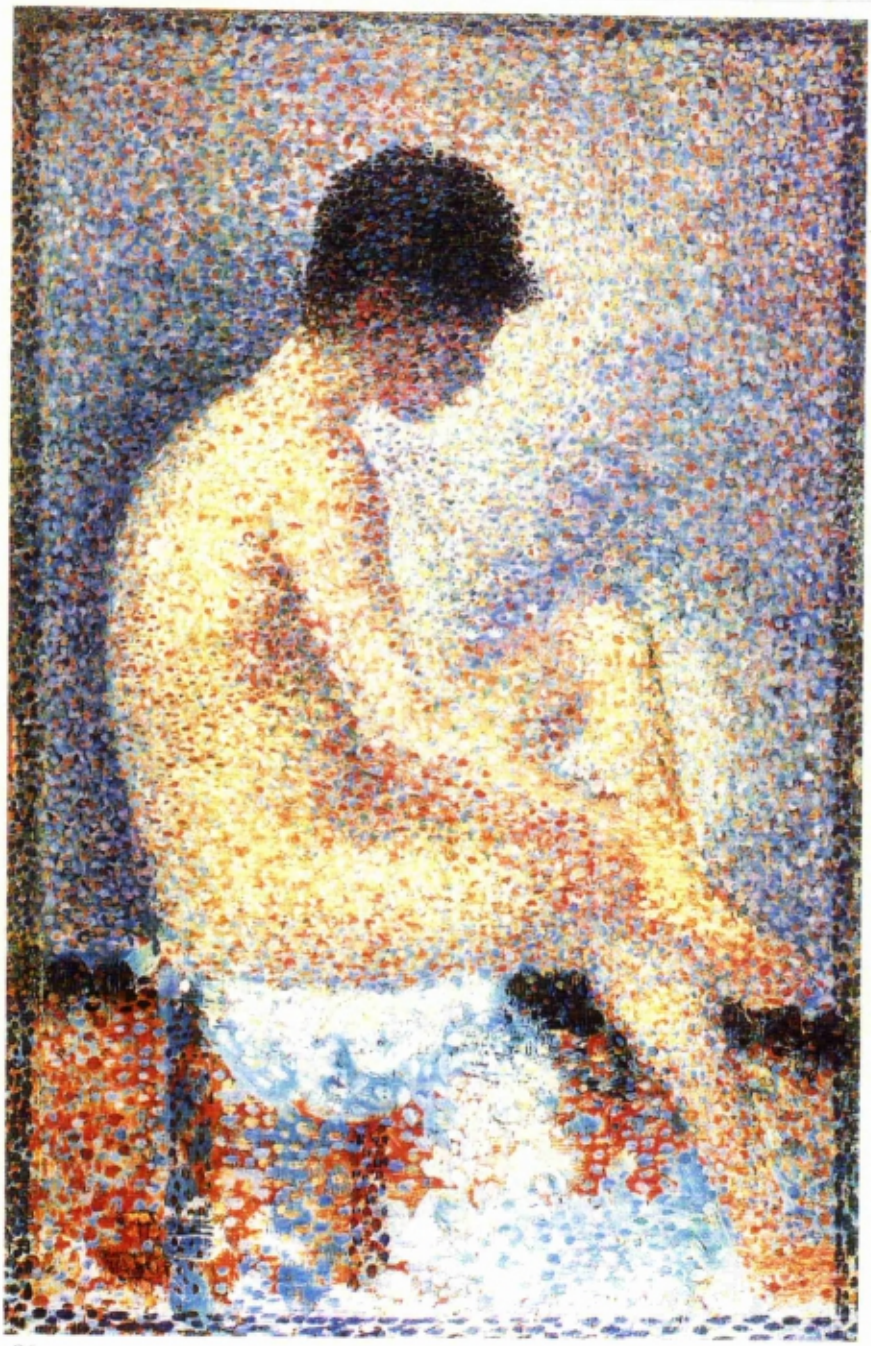
60b
Section La Parade, trombonist's shirt

61a
Poseuse de face, 1886
61b
Poseuse de face, 1887

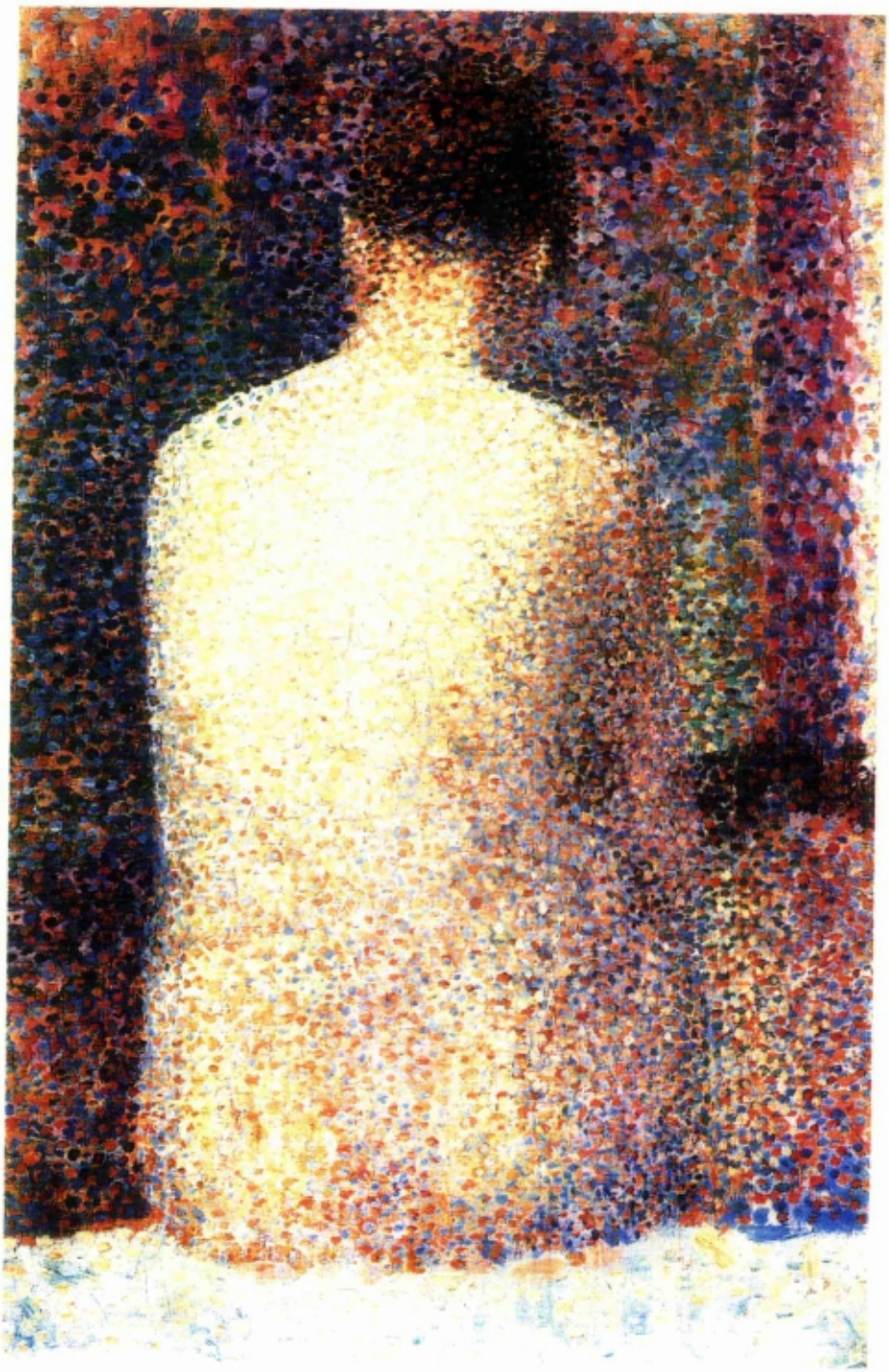




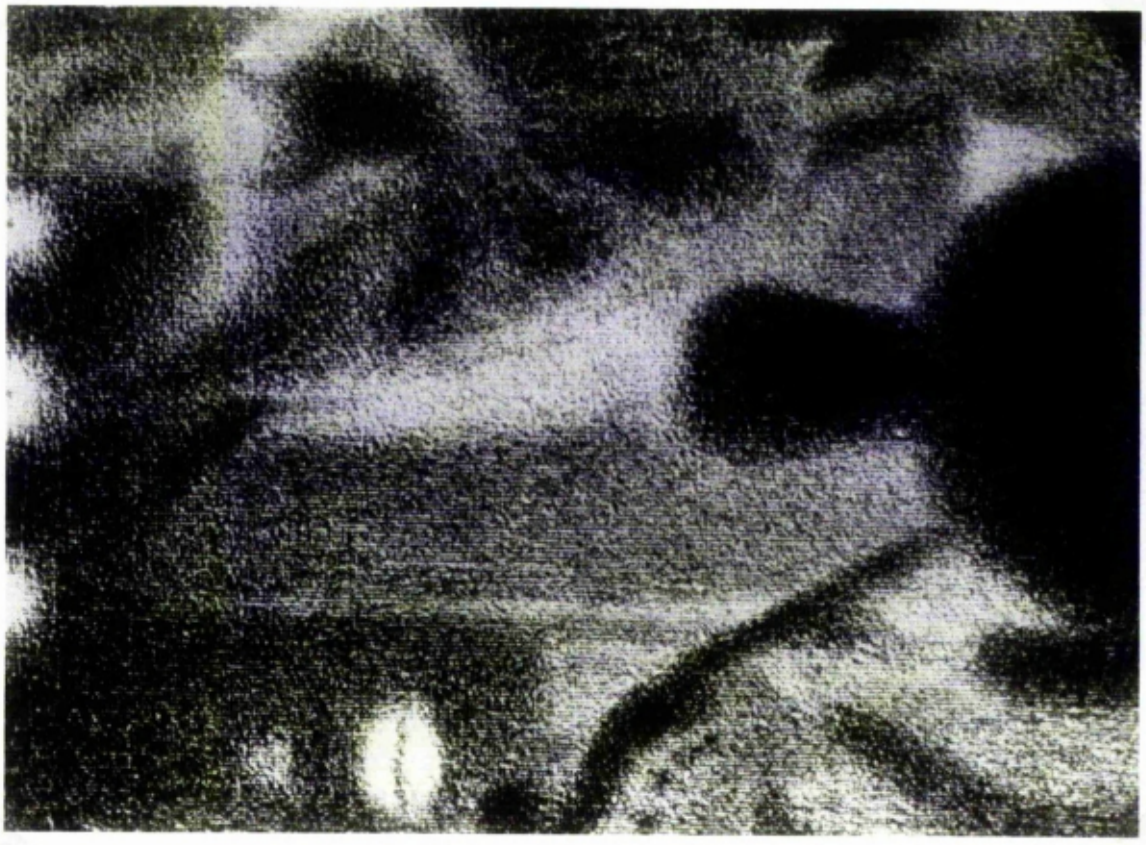
62a
Poseuse de profil, 1886



62b
Poseuse de dos, late 1886



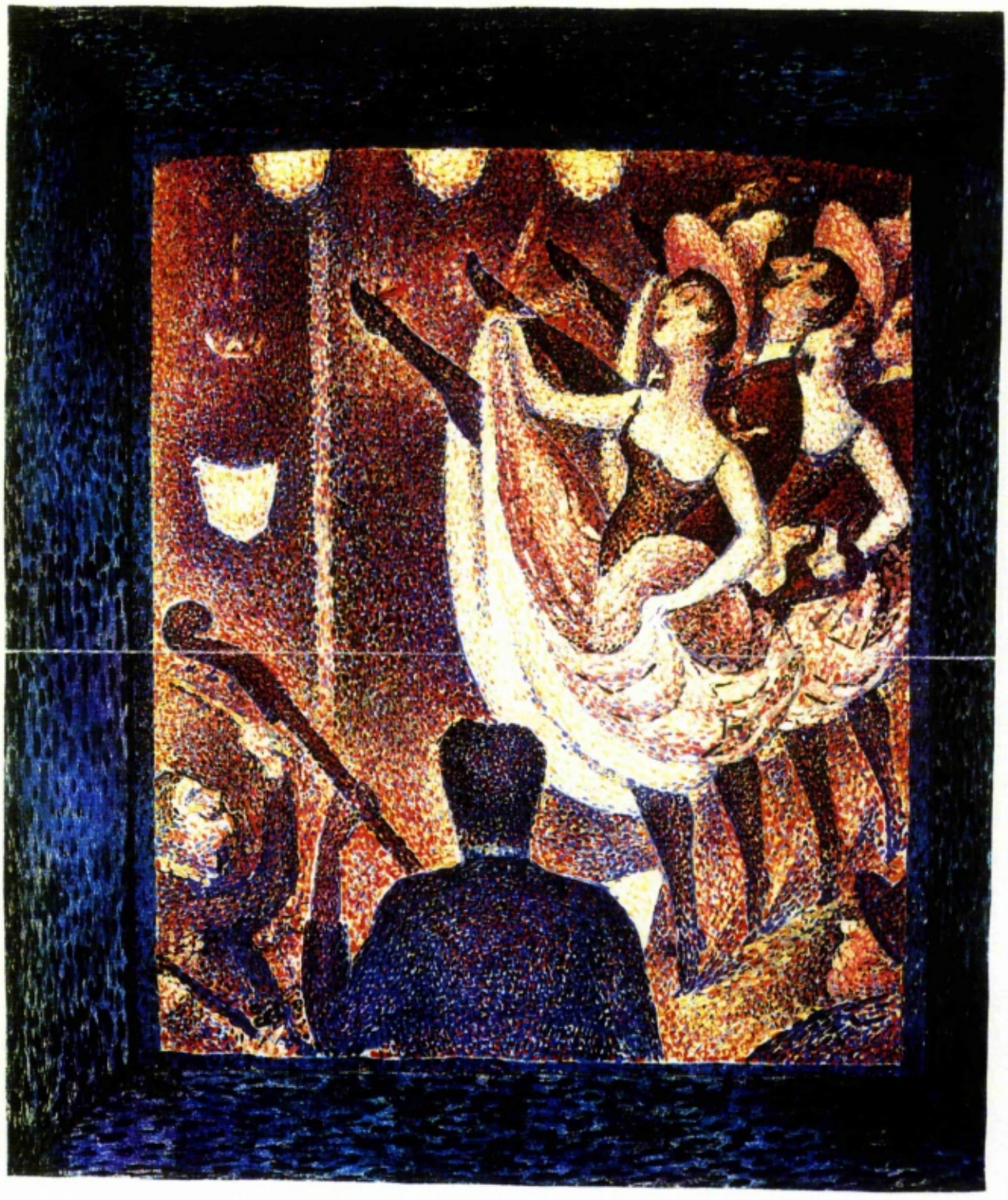
63a
Oil study, Le Chahut, c. 1889



63b
Conté sketch, based on Au Divan Japonais (1888)

64a
Courtauld study Le Chahut
64b
Final study Le Chahut

65
Le Chahut oil on canvas, final version

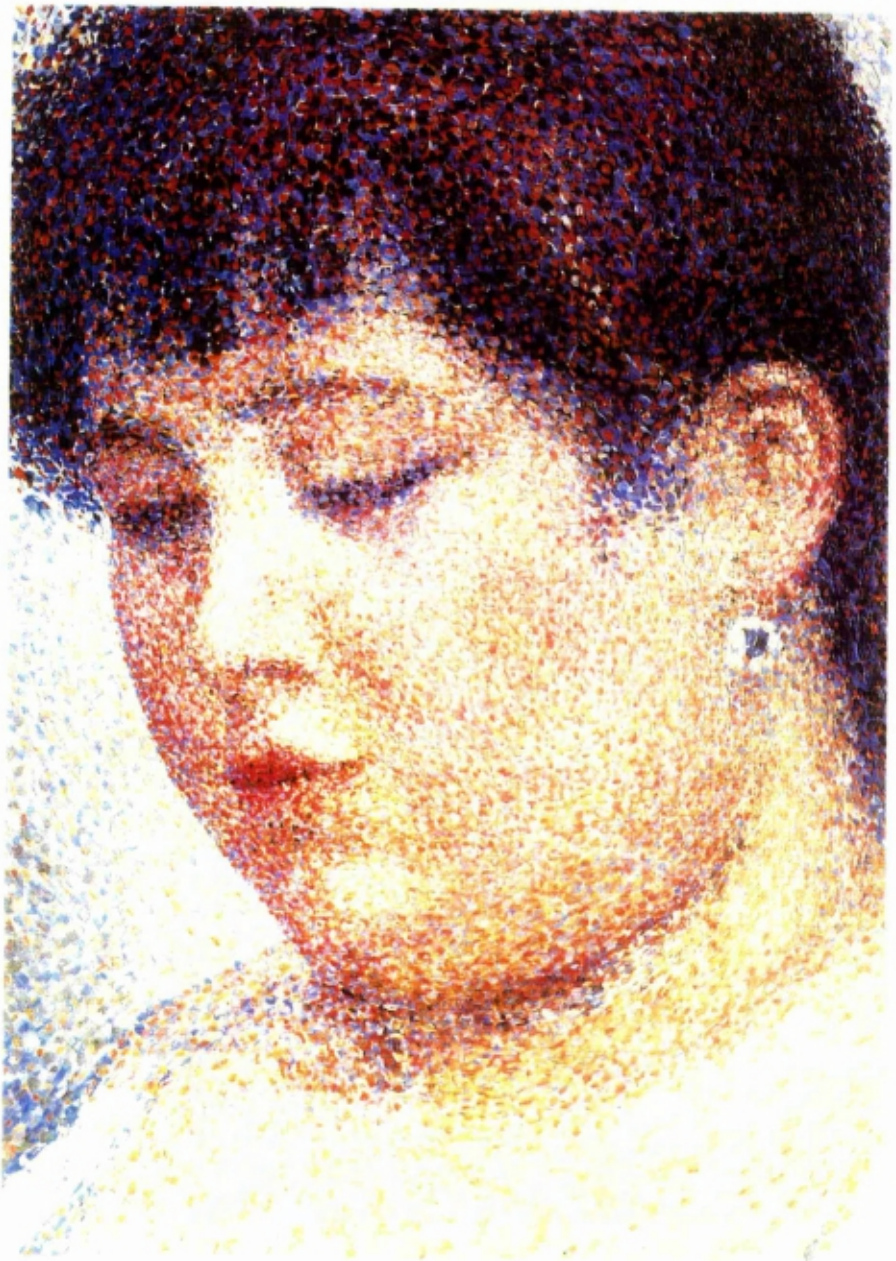


B/W étude Jeune femme se poudrant

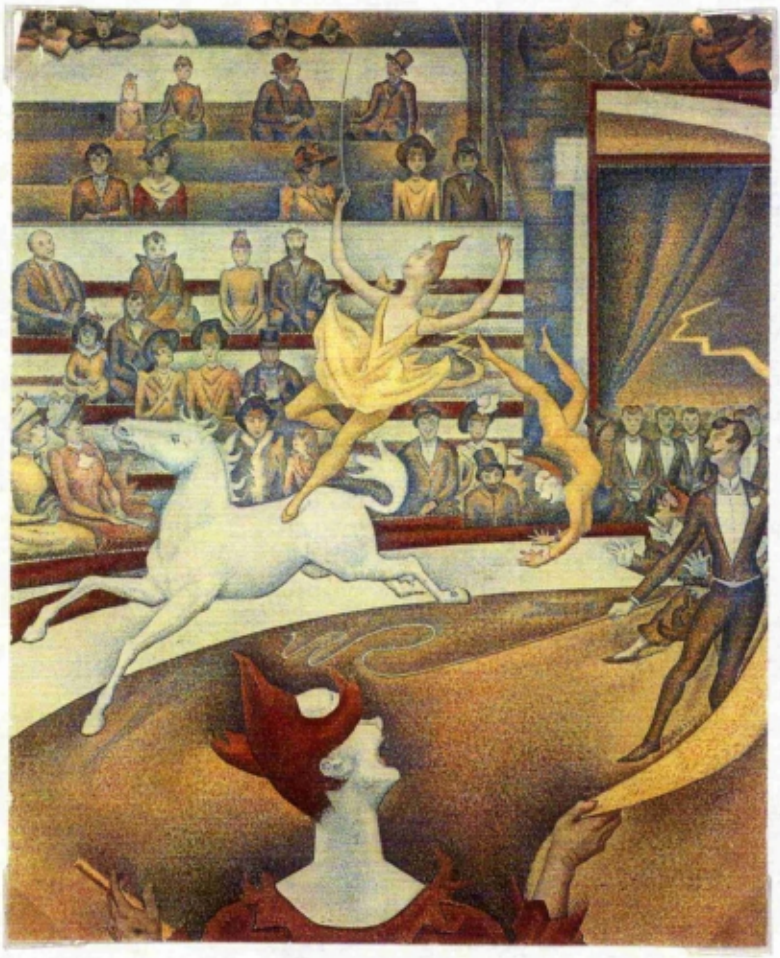
67a
Final version Jeune femme se poudrant

67b
Final version Jeune femme se poudrant

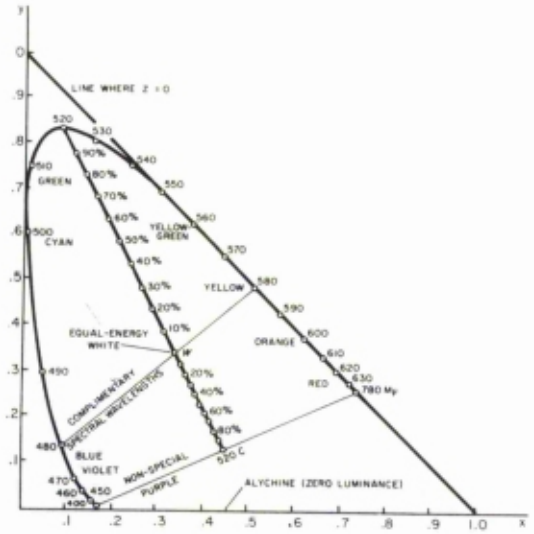
Detail Jeune femme se poudrant, face



69
Le Cirque, 1890-91



70
Le Cirque, section of border and frame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30%
20%
10%
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YELLOW
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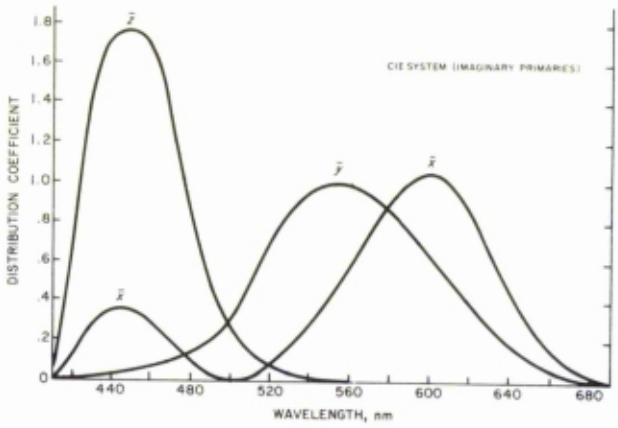
CIE SYSTEM (IMAGINARY PRIMARIES)
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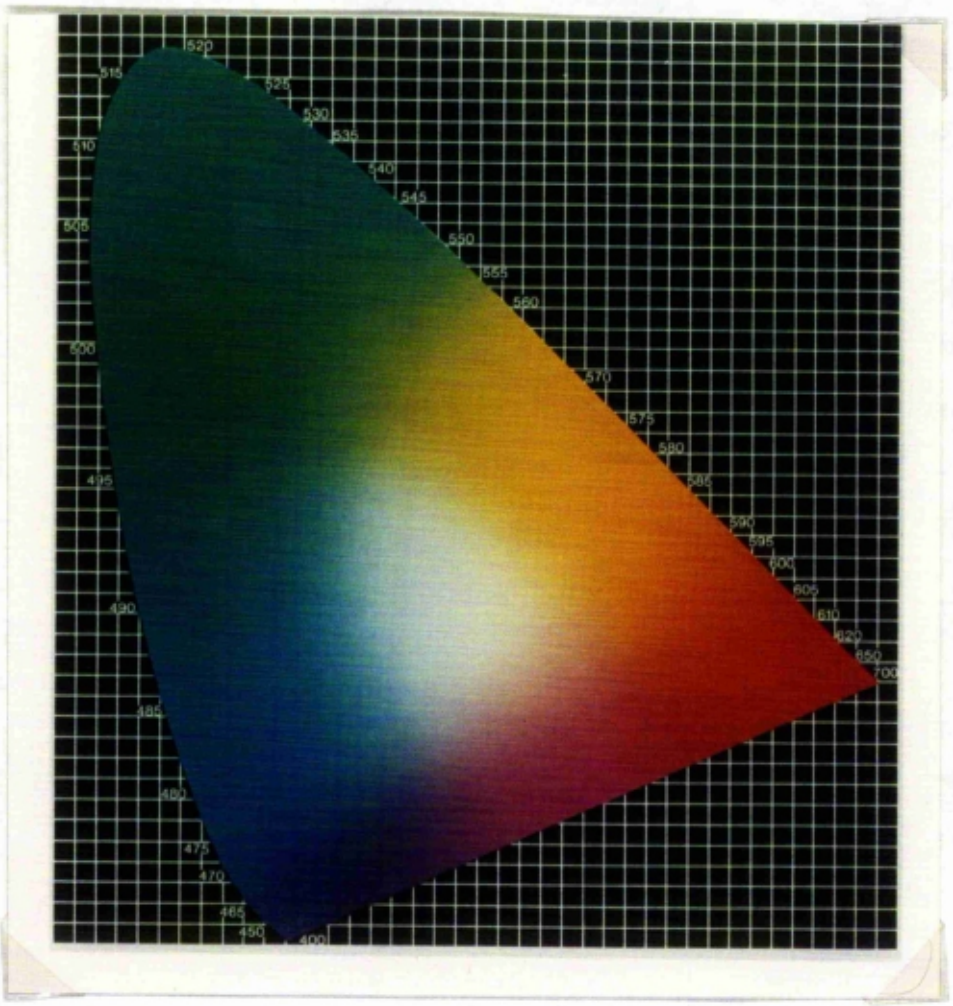
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Appendix B: Seurat's Palette

	1982 LGJ analysis			Seurat's palette	Signac's palette	Signac's palette
	1st	2nd	3rd	(Callen)	(Homer)	(Callen)
Vermilion	X	X	X	X	X	X
Cadmium Red					X	X
Organ.RedLake	X	X	X			
AlizrnCrimson						X
AlizrnLakes				X		
Madder Lakes					X	X
Rose Madder						X
Burnt Sienna	X					
Cadmium Yell.				X[1]	X[2]	X[3]
Chrome Yellow	X	X	X			
Zinc Yellow		X				
Composed Grn1				X[4]	X	
Composed Grn2				X	X	
Chrome Green						X[5]
Veridian	X	X		X		X
Emer.Grn.	X	X			X	
CeruleanBlue				X	X	X
Ultramar.Blue	X	X		X		X
Cobalt Blue	X	X	X	X		X
Cobalt Violet				X	X	X
Lead White	X	X	X			
Zinc White				X		
Black	X					
	10	9	5	11	9	12

Homer listed the colours associated with La Grande Jatte as: Yellow, Green-Yellow, Green, Green-Blue, Cyan, Blue, Ultramarine Blue, Violet, Purple, Red, Orange and Orange-Yellow, plus White. None of these are specific enough to identify firmly.[6]

Rewald listed Seurat's version of Rood's colour wheel as: Yellow, Greenish-Yellow, Yellow-Green, Green, Emerald Green, Very Greenish-Blue, Greenish Cyanic Blue, Greenish-Blue, Cyanic Blue I, Cyanic Blue II, Blue, Ultramarine Blue-Natural, Ultramarine Blue-Artificial, Violet, Purple, Purple-Red, Carmine, Red, Vermillion, Minium (?), Orange, and Orange-Yellow.[7]

Rood's colour wheel included: Yellow, Greenish-Yellow, Yellow-Green, Green, Emerald Green, GCG Blue, GC Blue, Green Blue, Cyan-Blue 1, Cyan-Blue 2, Blue, Ultramarine Blue-Natural, Ultramarine Blue-Artificial, Violet, Purple, Red-Purple, Carmine, Sp. Red

---

1 Pale Yellow Cadmium and Mid- or Deep Cadmium were listed.

2 Listed Cadmiums and Cadmium Yellow Light.

3 Deep, Medium and Light Cadmium Yellows were listed.

4 The composed greens were identified as being comprised of Chrome Yellow and Prussian Blue.

5 Both Pale Chrome Green and Deep Chrome Green were listed.

6 Homer, Op.cit., p. 155.

7 Rewald, Post-Impressionism: From van Gogh to Gauguin, 3rd ed., New York, 1978, p. 76.

(?), Vermilion, Red Lead, Orange, and Orange-Yellow.[8] The differences between Rood's version and Seurat's version of Rood's diagram are underlined.

[8] Rood's colour contrast diagram from p. 250 of the 1879 1st American edition or p. 218 of the 1973 edition with the preface by Faber Birren.

Appendix D: Timeline

A general compilation of key events in and around Seurat's lifetime

1801 Thomas Young's Trichromatic Theory names colour primaries (R,G,V)

1810 Goethe's theory first pub. in Germany; English trans. 1840

1821 Helmholtz born

1839 Chevreul's De la loi du contraste simultané des coloeurs (Eng. trans. 1854, 1872, 1883)

1845 Field's Chromatics: Or the Analogy, Harmony and Philosophy of Colours

1848 Blanc made Director of Beaux-Arts

1852 Helmholtz clarifies Subtractive vs. Additive colour mixing

1855 Maxwell refines Trichromatic Theory (R,G,Bl/Vio)
Helmholtz begins 3 vol. series on Handbook of Physiological Optics, pub. from 1855-1866
1856 Maxwell's Theory of Perception of Colours

1859 Georges Seurat born
Charles Henry born
1860 Fechner's Elements of Psychophysics
1861 1st Impressionist Exhibition
1862 Blanc's theory first published in France
Delacroix dies

1867 Blanc's Grammaire des arts du dessin--optical mixes suggested, included a resumé of Chevreul's theories and an analysis of Delacroix' theory.
" Seurat reads Blanc's study of Delacroix in Gazette des beaux-arts; a 2-pt article.
" Seurat was influenced by Corot's ideas on tone in painting.

1869 Goethe's Theory of Colors

1871 Blanc's 2nd term as Director of Beaux-Arts (1871-1873)
1873 Blanc translated into English (frm. 1867 FR original)
1874 Seurat's earliest dated drawing
1875 von Bezold's Theory of Colour discusses harmony from neighbouring colours
16 yr. old Seurat enters design school, meets E. Aman-Jean
1876 Hering's Opponent Process Theory (B/W,R/G,Bl/Yel)
von Bezold translated into French
1877 Brücke's main theories on science of Beaux-Arts
1878 Hering's Theory of Light Sense published
" 19 yr. old Seurat enters École des Beaux-Arts under Lehmann, stays two years, serves in army as 19-20 yr. old.

1879 Rood's Modern Chromatics published in English. His experiments were done in daylight and gaslight.
" Edison's incandescent lamp born.

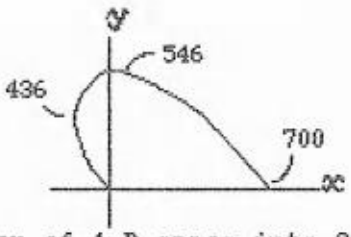
1881 Helmholtz's Popular Lectures published
" Seurat begins to eliminate using earth colours
" Seurat's drawings change from lines to his new technique which exhibits perfect control of all tonal changes, makes the drawings more luminous than colour works of same era.
" Seurat reads Blanc who mentions optical mixing and alludes to a relationship between music and colour
" Rood translated into French
" Seurat begins tests using daubs of colour--1st colour attempts, all drawing exps. until now
1882 Seurat begins tests using balayé--an influence from Rood? since work seems to be based upon laws of contrast of colours. Chevreul's 1839 work provides notion of simultaneous contrast of colours. Seurat used the coloured strokes to define masses rather than using lines and contours
1883 Seurat's drawings exhibit a highly successful fusion and tonal change as style begins to evolve
" Drawing of Aman-Jean accepted at Salon
" Une Baignade completed and shown at Salon. The studies for Une Baignade, done simultaneously with final canvas, were carefully done and fit together to form the final canvas.
1884 Seurat does sketches simultaneously with large canvasses; begins eliminating non-essentials in figure depiction
" La Grande Jatte begun
" Seurat meets Signac at 1884 Salon show. Together they consult Chevreul at Les Gobelins and Seurat adapts a prismatic palette soon thereafter.
" Seurat shows Une Baignade in May at Salon des Artists Indépendants show. Signac praises canvas for colour, contrast and balance
" Seurat studies under Henry in the autumn
" Indépendants show, 2 December
" Seurat shows Une Baignade and sketches for LGJ and Grandcamp at December Society show
1885 Henry's Introductions á une esthetique scientifique heralds in the Symbolist era
" 3 March Indépendants show cancelled
" The laws of contrast & comp. colours, tiny brushstrokes and pure colours of Seurat and Signac evolve into Divisionism. New converts to the method are L. Pissarro, Durand-Ruel, and Hayet.
" Seurat spends the summer at Grandcamp doing marine studies
" Seurat meets C. Pissarro in October through Signac
1886 LGJ reworked and exhibited May-June at 8th Imp. show; also shows Le Bec du Hoc and 4 other paintings
" The emotional significance of colour is studied by Seurat and some Symbolists feel Seurat's pictorial display is in line with their views
" Seurat works at Honfleur in June and uses "dot" exclusively
" Seurat shows 10 pieces in August Salon des Indé. show

" Seurat followers begin to see a pattern to his work and praise LGJ while the general reaction from the world is of scorn and disbelief
" Seurat begins Les Poseuses in autumn (finishes spring 1888)
1887 Seurat exhibits 7 paintings at Feb. Les Vingt show in Brussels
" 3rd Indépendants exhibition 26 March - 3 May
" Seurat paints La Parade
" Seurat reworks Une Baignade
" Seurat continues Les Poseuses
" Seurat begins Parade de Cirque in autumn
1888 Henry publishes Cercle Chromatique
" Seurat shows La Parade de Cirque at 4th Indé. show in March
" Seurat and Dubois-Pillet introduce coloured frames, no one approves; even Fénéon disapproves ("Le Néo-Impressionisme", L'Art Moderne, April 15, 1888, p. 122)
" Seurat finishes Les Poseuses in which LGJ is shown in a white frame as an outdoor scene portrayed in artificial light
" Seurat paints Port-en-Bassin; a complex and complete application of his theory on colour and line
1889 Henry publishes Rapporteur Esthétique
" Seurat shows Les Poseuses at 8th Les Vingt show in Brussels
" Seurat paints Le Chahut
" Seurat spends the summer at Le Crotoy
" Seurat begins to write down the essentials of this theory since his reluctance to do so in the past has hurt the cause
1890 Seurat paints and shows Jeune femme se poudrant at Indé. show
" Seurat shows Le Chahut in March at Salon des Indépendants
" Seurat spends his summer at Gravelines
" Seurat begins Le Cirque but never finishes it
" Instability of pigments has caused radical colour changes on the canvasses; the world doesn't always know how to react or to what they should been reacting
1891 Seurat dies in March. Cause of death? Diphtheria, infectious angina, or acute meningitis have all been listed

Appendix L: Colorimetry, the CIE, and the Munsell Colour System

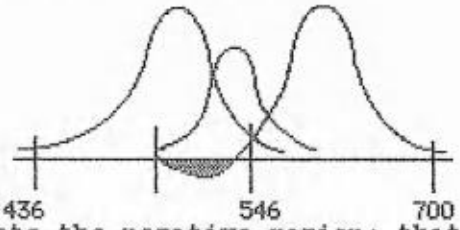
Isaac Newton is credited with the discovery that light shined through a prism produced different qualities and types of light; basically, the colours of the rainbow: red, orange, yellow, green, blue, indigo, and violet. Superimposition of these colours would produce a broader array of colours. However, in order to replicate these results, some way of identifying and labelling the colours is required; a way to measure the colour, or predict a resulting mixture, is needed.

One-dimensional colours as identified by colorimetry may be depicted on a chromaticity diagram which represents three-dimensional space. The 1-D colour space of the spectral locus moves from 400nm at blue to 700nm at red and this is then mapped out by assigning the x-axis to be "red", the y-axis to be "green", and the z-axis to be "blue". Since the z-axis is perpendicular to the x- and y-axes, all colour matches correspond to a wavelength in the rainbow. Furthermore, one can simplify the 3-D space by treating the colours as percentages of the mix wherein 100% red is at 700nm and 100% green is at 546nm; dialing through a monocrometer at 10nm intervals helps to determine these tri-stimulus matches. The original chromaticity diagram appeared like:



Unfortunately, such a conversion of 1-D space into 3-D colour space required that the locus be outside of the the bounds formed by the 3 primaries of red (700nm), green (546nm) and blue (436nm).

It may be seen from the drawing below that such a depiction

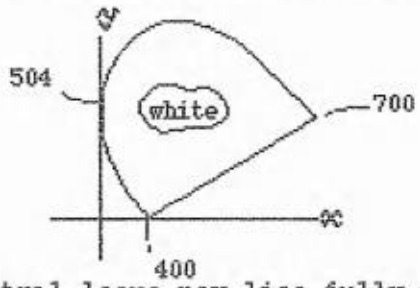


of red below 546nm runs into the negative region; that is, red must be subtracted to maintain the curve on the graph.

Since colorimetry is a system of colour measurement based on matching a colour by the appropriate mixture of three specified radiations, it cannot account for a necessary subtraction of the red wavelength from the region shown in the darkened area of the drawing since the spectral locus must be kept positive. An adjustment had to be made within the system.

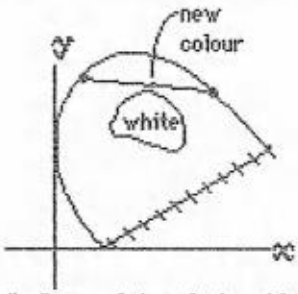
The Commission Internationale d'Eclairage (CIE) developed a specific to measure and qualify light based on the percentages of specific wavelengths contained within it. In 1931 the CIE adopted the spectral matrix as a world standard. This matrix,

which would cover all manifestations of colour, was transformed into the CIE matrix whose primaries were all imaginary. These 3 imaginary primaries, "x", "y" and "z", have no equivalent stimulus in the visible system yet they correspond to to "red", "green" and "blue". These colours were algebraically determined so that none would have a negative coordinate and were based on an additive mixture using monochromatic radiations instead of primaries. The altered chromaticity diagram with its positive display of the new system with the imaginary primaries looks like the following.[1]



This shows that the spectral locus now lies fully within the x and y areas. Adding all three valencies together equals 1 or what is the equivalent to white light. The boundary line of the "spectral color sequence" is now occupied by fully saturated monochromatic colours.[2] Thus, the final colour may be predicted when specific wavelengths are added together.

Full saturation, however, is not possible for all colours since monochromatic colours may be more saturated than the mixture which the relevant primary valencies indicates. These imaginary colours represent hypersaturated colours: they are above and beyond the normally perceived spectral colours; "x", "y" and "z" will produce no sensations to a viewer. Combinations of any two of these three primaries on the periphery produce a secondary colour on a line between the two chosen points.[3]



If the percentage of "x" combined to the percentage of "y" is equal, the resultant colour is white; thus, white is produced when the colours are said to be equidistant from each other. Purples, or non-spectral colours, fall on the line indicated by the crossbars.

Thus, by the implementation of 3 imaginary colours, the proper conversion to created positive coordinates, and the use of colorimetry, one can achieve any colour desired. This system is

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1 Also see Illustration 71 for the revised CIE graphs.

2 Harold, Küppers, Color: Origin systems uses, London, 1972, p. 106 The main substance of this appendix was obtained from perception class notes from Hershberger, Northern Illinois University, 1982.

3 See Illustration 71.

"...a purely theoretical, purely scientific, purely additive system, which permits the execution of exact mathematical calculations."[4] However, due to the fact that the primaries are "x", "y" and "z", one realizes that for this system, there really are no perceivable primaries as we know them.

The analog of the colorimetry system is found in the Munsell system. Albert H. Munsell developed this most widely used three-dimensional colour in 1905 and set up the final system, as we know it today, by 1941.[5] Depicting the panorama of colours in a 3-D space is done with three characteristics: value, chroma and hue. First, a central axis represents the brightness or value of a colour and gradually changes from black at the bottom to white at the top. Then, radiating concentrically outwards from the central axis is the quality of saturation or chroma; spectral colours are fully saturated, strong, and pure while desaturated colours are achromatic. Lastly, the hue, or colour itself, varies radially around the central axis.

The attributes of value, chroma, and hue are then sub-divided: the values march up the axis in 11 equally modulated steps; the chroma radiate outwards from the axis in 18 divisions which represent the comparative strengths or weaknesses of the colours; and, the hues rotate in 10 equal divisions around the axis. Munsell's system was so specific that colours could be identified regarding their position in the system via a code.[6] "R 8/12" would represent a red with a value of 8 and a chroma of 12, for example.

The Munsell system was modified by Newhall, Nickerson & Judd in 1943 so that three factors could be determined: First, an increase or decrease in brightness will cause a reduction in saturation; secondly, a change of hue will cause a change in brightness, and; thirdly, an increase in the numbers of hues reduces saturation of that sensation.[7] This helps to explain any relationships along psychological dimensions but fails to account for empirical observations related to the mixture of colour or of the phenomenal appearance of colours under different viewing conditions.[8]

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4 Küppers, Op.cit., p. 113.

5 Munsell set up the system as the result of his efforts to systematize Ogden Rood's "optical language". Personal letter from T. Synnott, Cambridge, MA to Professor Martin Kemp, 31 July 1990.

6 The system is so exact, in fact, that all USA astronauts are required to master Munsell's charts since photography was found to be insufficient in space travel. T. Synnott letter, 31 July 1990.

7 As discussed in Murch, G. Visual and Auditory Perception, p. 40.

8 Murch, Op.cit., p. 41.

Appendix M: How Parallel are the Visual Pathways?

The major debate in the past four years has been about the nature of the visual system and how separate the subsystems are within it, whether they are parallel or whether there is a significant amount of crossover between them.

Over 90% of the axons from the retina go through either the magno- or parvocellular subsystems, this is accepted and, to the stage of the V1, the segregation is maintained. However, work from behavioural sciences, neurophysiology and general visual research all point to a considerable amount of "cross-talk" between the cortical pathways from V1 onwards.[1]

Physiological work shows that the parvocellular system supports colour opponency (R/G or Y/B) and responds to colour regardless of luminance while the magnocellular system ceases to function at isoluminance. This was discussed in detail in Chapter 6. This interesting find now indicates that although the magno system can respond from as little as 2% contrast, when the parvo system requires at least 10%; yet, if the magno system has triggered itself, the parvo system can activate from that action.[2] This, combined with behavioural evidence, shows that the P and M pathways are "..anatomically and functionally distinct, but their basic specializations appear to be for low-level properties, such as spatial and temporal frequency."[3] This means that, when the contrasts are increased, both the P and M pathways can detect their specialized portions from the overlapping system but this is contingent upon temporal and spatial frequencies and, one system may affect the other.

Special attention has been focussed on the isoluminant studies which played such a key role in determining and providing support for the segregated visual pathways. In addition to the expected, poor response from the M pathway, the P pathway is impaired and functions with reduced capabilities. The P pathway cannot fully function at isoluminance. The built-in lower spatial resolution of chromatic vision combined with the lower effective contrast from chromatic stimuli, produce a slow response to luminance contrast.[4] This response may be due to the differences between the M and P pathways (as it has been taken to mean for years) or it may be due to other factors such as contamination from crossover effects. Therefore, isoluminant studies do not provide the conclusive evidence for the separate systems which they were once thought to provide.

Particular emphasis is now being given to the visual areas which make up the parietal and temporal pathways, which carry information from the M and P pathways, respectively. At the MT

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[1] See Merigan, W.H. and Maunsell, J.H.R. "How parallel are the primate visual pathways?" Annual Review of Neuroscience, 1993, 16: 369-402 for a complete listing of the research done in these fields in the past four years.

[2] Ibid, p. 374.

[3] Ibid, p. 377.

[4] Ibid, p. 391.

(or V5) and V4 levels, colour and direction factors remain selective but orientation, speed, binocular disparity and contrast sensitivity are the same for temporal and parietal pathways.[5] So, although there are distinct pathways at this level of processing, they are not as clearly segregated as they were at the initial stages of processing.

What conclusion may be drawn from this? That,

> "overall, the available anatomical and physiological data suggest that the relationship between the M and P pathways and the parietal and temporal pathways is **asymmetric**. The M pathway seems to dominate the parietal pathway, although some P pathway contributions are found. On the other hand, both the M and P pathways contribute appreciably to the temporal pathway."[6]

Perhaps, "asymmetric" is the key word. The visual system is not as clearly segregated as it was once thought to be and, under varying conditions, even the expected may not occur as the system shifts first one way and then another.

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[5] Ibid, p. 382, 384.

[6] Ibid., p. 390.

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