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LASZLO MOHOLY - NAGY

the documents of modern art

wittenborn, schultz, inc., new york

the new vision and abstract of an artist

László **moholy-nagy**

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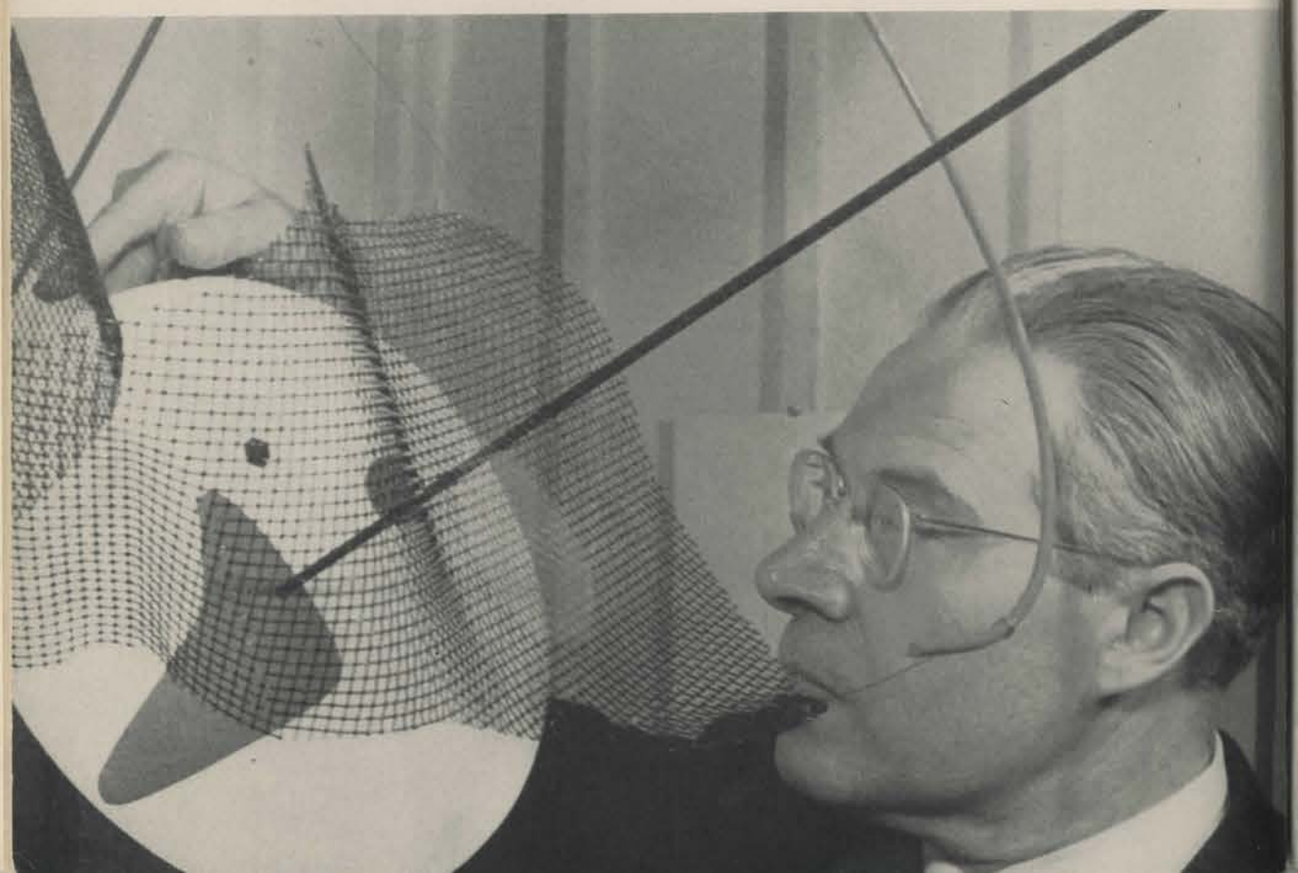

The documents of modern art: Director • Robert Motherwell

The New Vision 1928 fourth revised edition **1947**
and
Abstract of an Artist

László Moholy-Nagy

Wittenborn, Schultz, Inc. New York, 1947

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Frontispiece: L. Moholy-Nagy, 1946. Photo by Vories Fisher

Cover and typography by *Paul Rand*

Preface: It was in Berlin in 1922 that I first met Moholy-Nagy. Impressed by the character and direction of his work, I offered him a professorship at the "Bauhaus," the school of modern design which I had founded and was then directing at Weimar.

Moholy was one of my most active colleagues in building up the Bauhaus; much that it accomplished stands to his credit. The opportunities that the Bauhaus afforded for art of every kind must have proved especially inspiring to a nature so versatile, and a talent so many-sided as Moholy's. He constantly developed new ideas. These proved as fruitful to the school as to his own development. But his varied activities — in photography, theater, films, typography, and advertising design — neither diminished nor disseminated Moholy's powers as a painter. On the contrary, all his successful efforts in these mediums were simply indirect but necessary by-paths on his route to the conquest of a new conception of space in painting. This conception is for me his major contribution to the leadership of modern art. He succeeded in projecting various interests into his painting; he thus created a new pictorial unity, peculiar to himself.

His conception of spatial problems may be difficult to understand. We can perhaps best explain the task of such an abstract painter by the example of music. Like painting, musical composition consists of form and content. But its form is only in part a product of the composer, since, in order to make his musical ideas comprehensible to any third person, he makes use of counterpoint, which is a convention agreeing to divide the world of sound into certain intervals specified by fixed laws. These laws of counterpoint, harmony, and scales vary among different peoples and epochs, and

changes are slow; that is, they are not confined to individuals. In earlier days the visual arts also had established firm laws, a counterpoint regulating the structure of space. The art academies that had the task of keeping up and developing these rules somehow forgot them, and art decayed. The abstract painters of our day have used their creative powers to establish a new counterpoint of space, a new vision. This is the core of their achievement. In the history of painting, the content of what is portrayed recedes before the more important problem of space. Consider how long it took for the painter to master the structure of perspective in pictures. Our artistic conception has now developed further. Today we are confronted by new problems, e.g., the fourth dimension and the simultaneity of events, ideas foreign to former periods, but inherent in a modern conception of space. The artist often senses a coming discovery before its advent. Science now speaks of a fourth dimension in space, which means the introduction of an element of time into space. Before the first World War, futurist and cubist artists were already attempting to introduce movement into action, that is, the actual passing of time into hitherto static pictures. For example, Delaunay's well-known picture "The Eiffel Tower" was intended to be a pictorial representation of the sensations of a passenger going up the Eiffel Tower in the elevator — of impressions which follow one another in space.

From this notion to a picture by Moholy is a long step forward on the way to the conquest of space. Moholy soon recognized that we can comprehend space best by means of light. His work has been a mighty battle to prepare the way for a new vision; he has attempted to extend the boundaries of painting, and to increase the intensity of light in the picture by the use of new technical means, which approximate the intensity of light in nature. Moholy has observed and registered light with the eye of the camera from the perspective of the frog and the bird; he has tried to master his impressions of space and to transform them into new spatial relationships in his paintings and in his other works. To quote his own words, a creation in space is "an interweaving of parts of space, which are anchored in invisible, but clearly traceable relations, and in the fluctuating play of forces." This indeed describes his pictorial creations.

A thinker and educator, Moholy felt the urge to find objective definitions for the new space conception which had sprung up from his work and that of other contemporary leaders. Early in 1928 he wrote "Von Material zu Architektur" (Albert Langen Verlag, München) which is based on his educational experience and lectures at the Bauhaus between 1923 and 1928. A revised English edition, published under the title "The New Vision" (Brewer, Warren & Putnam, Inc., New York, 1930, and W. W. Norton, New York, 1938) has long been out of print. The increasing demand for this book, which has been so stimulating and helpful to students of modern art and design, has brought about the issue of the present new, revised, and greatly enlarged edition.

"The New Vision" has proved to be more than a personal credo of an artist. It has become a standard grammar of modern design.

Walter Gropius

Contents:

László Moholy-Nagy

1895 b., Borsod, Hungary.
1915 after law studies at the University of Budapest, turns to painting and writing.
1916 Budapest. Co-founder of the review "Jelenkor".
Member of Hungarian art group "MA".
1920–1923 Berlin. Co-founder of Constructivism. First photograms (cameraless photography) 1921. Writing for "MA", "De Stijl", "Cahiers d'art", etc. Co-author, "Buch Neuer Künstler" (Vienna, 1922), an anthology of modern art.
1923–1928 Weimar, Dessau. Professor in the Bauhaus. Co-editor (with Walter Gropius) of the 14 Bauhaus books, and the quarterly, "Bauhaus". Co-founder and editor of the international art review "i 10" (Amsterdam, 1926).
1928–1934 Berlin. Experiments with new materials: galalith, trolit, cellon, rhodoid, enamel, aluminum, etc. Typographical work. Settings for Piscator's theater and for the State Opera, Berlin. Abstract movie "Light Display, Black and White and Gray" (1930).
1935–1937 London. Exhibitions of paintings, sculpture, and photographs. Makes "Lobsters", one of the "ten best films" of 1936. Special effects for H. G. Wells' film "Things to Come".
1937 Director of Institute of Design, Chicago.
1946 d., Chicago.

Bibliography: Books by Moholy-Nagy:

"Horizont", Vienna, 1921
"Buch Neuer Künstler" (with L. Kassák), Vienna, 1922
"Malerei-Fotografie-Film", Munich, 1925
"Die Bühne im Bauhaus" (with Oscar Schlemmer), Munich, 1925
"Von Material zu Architektur", Munich, 1929 (transl. as "The New Vision", Brewer, Warren and Putnam, N. Y., 1930; 2nd ed., W. W. Norton, N. Y., 1938; 3rd, completely revised edition, with "Abstract of an Artist", Wittenborn and Company, N. Y., 1946)
"Fototek" (60 photos), Berlin, 1929
"Telehor", Brno, 1936
"The Streetmarket of London" (with Mary Benedetta), London, 1936
"Eton Portrait" (with Bernard Ferguson), London, 1936
"Oxford University Chest" (with John Betjeman), London, 1937
"Vision in Motion", Paul Theobald, Chicago, 1947

Books on the Bauhaus:

Walter Gropius, "The New Architecture and the Bauhaus", N. Y., 1936
Herbert Bayer, Walter Gropius and Ise Gropius (editors), "Bauhaus, 1919-1928", N. Y., 1938

The New Vision:

Foreword to the third English edition: The New Vision was written in the years 1925-28, and published in this country in 1930 and 1938. Though the last edition was quickly exhausted, I did not press for further printings because I was planning a new book in which I intended to report on the results of my work in recent years. My tasks, however, as director of the Institute of Design, Chicago, have taken up my time to the extent that I have not as yet been able to publish my new book. The requests for a reprint of "the new vision" steadily increased, the publishers and I have therefore decided on this new edition supplementing it with the "Abstract of an Artist."

• Since 1938, when "the new vision" was last published, great changes have taken place. The Institute of Design, Chicago, which continued the Bauhaus education and adapted it to the American scene, is now six years old. It has proved its vitality by attracting a large number of students to its regular day classes as well as to evening classes and the summer sessions, and by sending its graduates to important positions. Its Board of Trustees is composed of civic and industrial leaders of the city of Chicago, and its classes serve the great Chicago firms in industry and commerce.

The interest in the creative educational approach of the Institute is constantly growing. This is attested by a steady flow of visitors from all over the country. Interested laymen, professionals and industrialists come to the school to see its exhibitions and to study the efforts of its faculty and students.

With their help and that of other responsible citizens I hope that in a not too distant future we shall be able to build a new campus. There the ideas of the Institute can be realized with greater clarity, crystallizing a new creative education that strives to integrate the best that mankind can offer to youth.

• As an appendix, this edition contains the brief essay, never hitherto published, entitled "Abstract of an Artist." It is an attempt to picture the feelings, thoughts and efforts upon which my artistic development has been based. **L.M.-N.** Chicago, 1945.

Foreword to the second English edition: The New Vision was written to inform laymen and artists about the basic element of the Bauhaus education: the merging of theory and practice in design.

In its experimental state this school could serve only a small group of students. The great majority of those interested had to rely on incidental information. It was mainly for them that the fourteen old Bauhaus Books were published in Germany. The importance of these publications became greater in 1933, when the Bauhaus was closed by the German National Socialist Government; these books then remained the only authentic records of fourteen years of educational work.

Now a *new* Bauhaus is founded on American soil. America is the bearer of a new civilization whose task is simultaneously to cultivate and to industrialize a continent. It is the ideal ground on which to work out an educational principle which strives for the closest connection between art, science, and technology.

To reach this objective one of the problems of Bauhaus education is to keep alive in grown-ups the child's sincerity of emotion, his truth of observation, his fantasy and his creativeness. That is why the Bauhaus does not employ a rigid teaching system. Teachers and students in close collaboration are bound to find *new ways* of handling materials, tools, and machines for their designs. The characteristic pioneer spirit which we find unimpaired in our American students admirably serves this task. In view of the new culture which now constitutes our background and of the fact that two decades have elapsed since the foundation of the first Bauhaus, the program of the school in America has been slightly altered. In the new Institute as well as in the old, however, the preliminary course is considered as a fundamental part of the training. Here the student tests his abilities, and experiences his first contact with the kind of work in which he will later specialize. Here the tendencies of his aesthetic orientation and his creative abilities for practical work are directed, and a path is cleared through the bewildering multitude of art "isms." Intensive and repeated pre-occupation with the elements of creation heightens his discrimination between dilettantish and superficial design on one side, and functional *organic design* on the other. It is the practical exercise, and the pleasure in sensory experiences which lead him to a security of feeling, and later to the creation of objects which will satisfy human needs that are spiritual as well as utilitarian.

This book contains an abstract of the work in our preliminary course, which naturally develops from day to day in practice.

The work of the Bauhaus would be too limited if this preliminary course served only Bauhaus students; they, because of constant contact with instructors, and with practical workshop experience, are least in need of its record in book form. More important — one might say the essential condition — for the success of the Bauhaus idea is the education of our contemporaries outside the Institute. It is the public which must come to understand and to aid in furthering the work of designers, if their creativeness is to yield the best results for the community. To prepare this understanding is the main task of The New Vision. It is my hope that it will stimulate those who are interested in art, research, design, and education.

A brief account of the Bauhaus may be found in the "Handbuch der Arbeitswissenschaft," edited by Dr. Fritz Giese (Marhold Verlagsbuchhandlung, Halle-S.) under the heading Bauhaus Work. In the Bauhaus book "Staatliches Bauhaus in Weimar 1919-1923," Walter Gropius discussed thoroughly the Course of the Bauhaus Work. Finally his book "The New Architecture and the Bauhaus," published by the Museum of Modern Art, New York, is the best source in English. **L.M.-N.** 1938.

One can never

experience art through

descriptions.

Explanations and analyses

can serve at best

as intellectual preparation.

They may, however,

encourage one to make

a direct contact

with works of art.

Introduction: At any given moment man's position is defined by everything he does. This position is determined by his biological nature and by his participation in a given culture. This is quite apart from his personal satisfaction, which is grounded in the successful expression of his emotional pattern. This expression will be fruitful if it carries with it an "objective" meaning for all people. Upon this depends his contribution to the development of culture.

The more he can approximate the standards which actualize that objective quality, the greater his contribution will be. The individual's emotional existence flows here into historical continuity; the actual and momentary are transcended in the permanent structure of civilization.

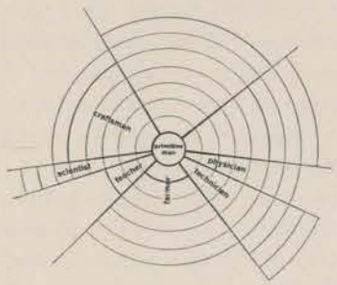
In art education at present we are striving toward those timeless biological fundamentals of expression which are meaningful to everyone. This is the first step to creative production before the meaning of any culture (the values of an historical development) can be introduced. We are not, therefore, immediately interested in the personal quality of expression which is usually called "art," but in its primordial, basic elements, the ABC of expression itself.

This does not mean that "art" is put aside, nor that the values within its domain are to be questioned. On the contrary, it is precisely these values which are firmly anchored in the biological. Still, for the majority of people this fact is obscured by a tendency to regard art as something unique and entirely individualistic.

We observe art because of its basic and common roots permeating life. We shall attempt to clarify them — at least in their essential points — without distressing ourselves unduly if at times we must make a detour in approaching the center of the problem, i.e., articulating the means of expression. From there we may then proceed to their individual interpretation.

Sectors of human development. A human being is developed by the crystallization of the whole of his experience. Our present system of education contradicts this axiom by emphasizing single fields of activity.

Instead of extending our realm of action, as primitive man was forced to do, since he combined in one person hunter, craftsman, builder, and physician, we concern ourselves with a single specific vocation, leaving other capacities unused.



The primitive man combined in one person hunter, craftsman, builder, physician, etc.; today we concern ourselves only with one definite occupation, leaving unused all other faculties.

Today tradition and authority intimidate man. He no longer dares venture into other fields of experience. He becomes a man of one calling; he has no longer first-hand experience elsewhere. His self-assurance is lost. He no longer dares to be his own healer, nor trust his own eyes. Specialists — like members of a powerful secret society — block the road to many-sided individual experience, the need of which arises from man's biological existence.

The choice of a calling is often determined by outside factors: a man becomes a candy-maker or a cabinet-maker because there is a shortage of apprentices in those trades; he becomes a lawyer or a manufacturer because he can take over his father's business.

The accent lies on the sharpest possible development of a single vocation, on the building of specialized faculties. "Market demand" is the criterion. A man becomes a locksmith or a lawyer or an architect (working inside a closed sector of his faculties), and if, after he has finished his studies, he strives to widen the field of his calling, aspires to expand his special sector, he is at best a happy exception.

Here our system of education has been found wanting, despite vocational guidance, psychological testing, and I.Q.'s.

A "calling" today means something quite different from following one's own bent, something quite different from solidarity with the aims and needs of a community. Everything functions — and functions alone — on the basis of a production system which only recognizes motives of material gain. One's personal life must, then, go along outside one's "calling," which is often a matter of compulsion, and regarded with aversion.

The future needs the whole man. Specialized training cannot yet be abandoned at a time when production is being put on an economic basis. But it should not begin so soon or be carried so far that the individual becomes stunted — in spite of his highly prized professional knowledge. A specialized education becomes meaningful only if an integrated man is developed in terms of his biological functions, so that he will achieve a natural balance of intellectual *and* emotional power. Without such an aim the richest differentiations of specialized study — the "privilege" of the adult — are mere quantitative acquisitions, bringing no intensification of life, no widening of its breadth. Only men equipped with clarity of feeling and sobriety of knowledge will be able to adjust to complex requirements, and to master the whole of life.

The present system of production. Our modern system of production is imposed labor, a senseless pursuit, and, in its social aspects, without plan; its motive is to squeeze out profits to the limit. This in most cases is a reversal of its original purpose.

The chase after money and power influences the form of life, even the individual's basic feelings. He thinks of outward security, instead of his inner satisfactions. On top of this is the penning up of city people in treeless barracks, in an extreme contraction of living space. This cramping of living space is not only physical: city life has brought, with its herding into barren buildings without adequate open space, an emotional choking of the inhabitants.

Today neither education nor production springs from inner urges, nor from urges to make goods which satisfy one's self and society in a mutually complementary way.

The educational system is the result of the economic structure. During the frenzied march of the industrial revolution, industrialists set up specialized schools in order to turn out needed specialists quickly. These schools in very few instances favored the development of men's power. They offered them no opportunity to penetrate to the essence of things, or to the individual himself. But — to tell the truth — no one was concerned with this because no one could foresee the destructive results.

Not only the working class finds itself in this position today; all those caught within the mechanism of the present economic system are, basically, as badly off. At best the differences are material ones.

But how about technical progress? It might be easily supposed therefore that the present system of industrial production, and especially our technical progress, ought to be condemned. Numerous writers and politicians suggest this. But they mix effect with cause. In the XIXth century attempts were made to reach a correct diagnosis, but

suggested a wrong therapy. Gottfried Semper declared in the 1850's, for example, that if iron ever was to be used in building it would have to be used (because of the real nature of iron) in the fashion of the transparent spider-web. But, he continued, architecture must be "monumental," and thus "we never shall have an iron-architecture." A similar mistake was made by the Ruskin-Morris circle in the 1880's. They found that industrial mass production killed quality of craftsmanship. Their remedy was to kill the machine in turn, and go back to handwork. They opposed machines so strongly that, in order to deliver their hand-made products to London, they ran a horse coach alongside the hated railway. In spite of this rebellion against the machine, technical progress is a factor of life which develops organically. It stands in reciprocal relation to the increase in number of human beings. Here is its real justification. Despite its distortion by profit interests, by struggle for mere accumulation and the like, we can no longer think of life without technical progress. It is an indispensable factor in raising the standard of living.

The possibilities of the machine — its abundant production, its ingenious complexity on the one hand, its simplification on the other, have necessarily led to a mass production which has its own significance. The task of the machine — satisfaction of mass requirements — must be held in the future more and more clearly in mind. The true source of conflict between life and technical progress lies at this point. Not only the present economic system, but also the process of production call for improvement from the ground up. Invention and systematization, planning and social responsibility must be applied to this end.

A common error today is to view questions of efficiency from a technical and profit standpoint. The Taylor system, the conveyor belt, and the like remain misinterpreted as long as they turn man into a machine, without taking into account his biological requirements — work, recreation, and leisure.

Not against technical progress, but with it. The solution lies, accordingly, not in working against technical advances, but in exploiting them for the benefit of all. Man can be freed through techniques, if he finally realizes their function: i.e., a balanced life through full use of our liberated energies.

Only when it is clear to the individual that he has to function as a productive entity in the community of mankind will he come closer to a true understanding of the significance of technical progress. We should not be blinded by the intricacies of the amazing technical process of production, but should engage our main interest on the sound planning of our lives.

Today we are faced with nothing less than the reconquest of the biological bases of human life. When we recover these, we can then reach a maximum utilization of technical progress in the fields of physical culture, nutrition, housing, and industry — a thorough rearrangement of our present scheme of life. Even today it is believed that less importance needs to be attached to biological requirements than formerly, thanks to our technically exact and calculable ways of dealing with them. It is thought that securing sleep by veronal, relieving pain by aspirin, and so on, can keep pace with organic wear and tear. In this direction the "progress" of civilization has brought with it dangers. Apparent economies may easily deceive. For technical progress should never be the goal, but instead the means.

Biological needs. In this book the word "biological" stands generally for the laws of life which guarantee an organic development. If the meaning of "biological" were

conscious, it would protect many people from damaging influences. Children usually act in accordance with biological laws. They refuse food when ill, they fall asleep when tired, and they don't show courtesy when uninterested. If today's civilization would allow one more time in order to follow biological rhythms, lives would be less hysterical and less empty.

The basic biological needs are very simple. They may change or be deformed by social and technical processes. Great care must be taken that their real significance should not be distorted. This often happens through a misunderstood luxury which thwarts the satisfaction of biological needs. The oncoming generation has to create a culture which does not weaken, but which strengthens genuine biological functions.

Efforts toward reform. The creative human being knows (and suffers from it) that the inherent values of life are being destroyed under the pressure of moneymaking, competition, and trade. He suffers from the materialistic evaluation of his vitality, from the flattening out of his instincts, from the impairing of his biological balance.

And yet, though the present social structure is a thoroughly unsuitable medium for the balanced outlet of human capacities, in the private life of individuals some glimpses of a functional understanding have already appeared.

The advances in art, literature, the theater and the moving-picture in our time, and various educational movements give important indications of this fact. So does the interest in physical culture, in recreation and leisure, and in treatment by "natural" rather than chemical methods.

Such efforts, taken as a whole, portend a new world. But no small unit of this growth should be studied as an isolated fact. The relations of various subjects (science, art, economics, technical knowledge, educational methods) and their integration must be constantly clarified within the social whole.

Not the product, but man, is the end in view. Proceeding from such a basic readjustment we may work out an individual plan of life, with self-analysis as its background. Not the occupation, not the goods to be manufactured, ought to be put in the foreground, but rather recognition of man's organic function. With this functional preparation, he can then pass on to action, to a life evolved from within. We then lay down the basis for an organic system of production whose focal point is man, not profit.

Everyone is talented. If he is deeply interested in his work, every healthy man has a deep capacity for developing the creative energies in his nature.

Everyone is equipped by nature to receive and to assimilate sensory experiences. Everyone is sensitive to tones and colors, everyone has a sure "touch" and space reactions, and so on. This means that everyone by nature is able to participate in all the pleasures of sensory experience, that any healthy man can become a musician, painter, sculptor, or architect, just as when he speaks, he is "a speaker." That is, he can give form to his reactions in any material (which is not, however, synonymous with "art," which is the highest level of expression of a period). The truth of this statement is evidenced by actual life: in a perilous situation or in moments of inspiration the conventions and inhibitions of daily routine are broken, and the individual often reaches an unexpected plane of achievement.

The work of children and of primitive peoples offers other evidence. Their spontaneous expressions spring from an inner sense of what is right, as yet unshaken by

outside pressure. These are examples of life governed by inner necessities. If we consider that anyone can achieve expression in any field, even if it is not his best outlet, or essential to society, we may infer with still greater certainty that it must be possible for everyone to comprehend works already created in any field.*

Such receptivity develops by stages, according to disposition, education, mental and emotional understanding. If the broad line of organically functioning life is once established, the direction of all human production is clearly indicated. Then no work — as is often the case today with industrial production and its endless subdivisions — could be felt as the despairing gesture of a man being submerged. All would emerge as an expression of organic forces.

Conclusions. In conclusion we may say that the injuries caused by a technical civilization can be combatted on two fronts:

1. By a purposeful observation and a rational safeguarding of organic, biologically conditioned functions — through art, science, technology, education, politics.

2. By relating the single results to all human activities.

In practice these two approaches interlock, though logically step 1 must prepare for step 2.

The responsibility for carrying out the plan lies with each individual. There is no more urgent problem than that of realizing our desire to use fully man's constructive abilities. For the last 180 years or so, we have been thinking about the problem, talking about it, and attempting to act on it. Even today our practice is at best a statement of belief, and not a realization. Partial solutions cannot be recommended; we are now too involved in the problems of industrial society. Partial rebellion is only evidence of monstrous pressure, a symptom. Only the person who understands himself, and cooperates with others in a far-reaching program of common action, can make his efforts count. Material motives may well provide the occasion for an uprising or revolution, but they can never be the deciding cause if constructive changes are to be hoped for.

The revolutionist should always remain conscious that the class struggle is, in the last analysis, not about capital, nor the means of production, but actually about the right of the individual to have a satisfying occupation, a life-work that meets inner needs, a balanced way of life, and a real release of human energies.

Utopia? Utopia? No, but a task for pioneers. We need Utopians of genius, a new Jules Verne, not to sketch the broad outlines of an easily imaginable technical Utopia, but to prophesy the existence of the man of the future, who, in the realm of the instinctive and simple, as well as in the complicated relations of life, will work in harmony with the basic laws of his being. Leonardo da Vinci, with his gigantic plans and achievements, is the great example of the integration of art, science and technology. It seems that our time will be able to create similar basic conditions, a similar atmosphere, and to produce a similar personality. Our time is one of transition, one of striving toward a synthesis of all knowledge. A person with imagination can function now as an integrator. Of course he has to push aside the desire for the complexity which only a mature epoch can offer. He must be a pioneer in the vast and unbroken territories of our period, where every action could lead to creative solutions. If one

* Further evidence will be furnished by reference to the basic writings of Heinrich Jacoby, who has made this problem his life-work. He concentrated particularly on the problem of musical and non-musical persons. His writings are among the valuable sources upon which educational work can draw.

doubts that an individual can ever achieve so much, it may be that it will not be individuals alone, but working communities who do. Scientists have already built an international system of research. The next step must be the solidarity of all cultural workers and their conscious collaboration — the major obligation of those who have already arrived at consciousness of an organic way of life. Pioneer work with this aim in view: man's functional capacities must be safeguarded, but not only safeguarded; the outward conditions for their realization must be put at his disposal. At this point the educational problem merges into the political, and is perceptible as such, so far as the student goes into everyday life, and must make an adjustment to the existing order.

The "Bauhaus". The Bauhaus, an art university, founded by Walter Gropius in 1919 in Germany, attempted to meet the needs of group work. Although for reasons of convenience a division into semesters was retained, the old concept and content of "school" was discarded, and a community of workers established. The powers latent in each individual were welded into a free collective body. The pattern of a community of students was worked out by students who learned "not for school, but for life."

Such a community implies practice in actual living. Its individuals learn to master not only themselves, but also the living and working conditions of the environment. Their work, although starting out with the arts, must be a synthesis. This is what is meant when Gropius speaks about the "fatal legacy from a generation which arbitrarily elevated some branches of art above the rest as 'fine art' and in so doing robbed all arts of their basic identity and common life. But art is not one of those things that may be imparted . . ."

The educational program of the Bauhaus, or more exactly, its working program, rests upon this.

The first year in the Bauhaus is of decisive importance, especially for those young people who, as a consequence of customary education, have brought with them a sterile hoard of textbook information.

The first year their training is directed toward sensory experiences, toward the enrichment of emotional values, and toward the development of thought. The emphasis is laid, not so much on the differences between the individuals, as on the integration of their common biological features, and on objective scientific and technological facts. This allows a free, unprejudiced approach to every task. After this first year begins the period of specialized training, based on free vocational selection within the workshops. During this period the goal remains: man as a whole. Man — when faced with all the material and spiritual problems of life — can, if he works from his biological center, take his position with instinctive sureness. Then he is in no danger of intimidation by industry, the haste of an often misunderstood "machine culture," or by past philosophies about his creative ways.

Objectives and methods of Bauhaus education. The XXth century overwhelmed man with its inventions, new materials, new ways of construction, and new science. The boundaries of given callings were burst. New problems required more exact knowledge, greater control of far-reaching relations and more flexibility than the rigid schemes of tradition permitted.

The multiplication of mechanical appliances, and new methods of research, required a new intellectual orientation, a fusion of clarity, conciseness, and precision.

It is historically interesting that everywhere in the world outstanding new industrial

products emerged, but mainly unintentionally, that is, in fields where not tradition, but function determined form; in engineering construction, for instance, in acoustic, optical, chemical and medical instruments, and in machinery, railway and electrical equipment. But basically it was not industry, nor technical experts, but the artist pioneers who dared to proclaim the conception of "functional rightness." "Form follows function," Sullivan and Adler said. This created an atmosphere, stimulating a new understanding of form on the basis of changed technical, economic, and social conditions.

In Germany various groups concerned themselves with the problem of the creative; such as the Darmstadt artists' colony at Matildenhöhe; the "youth style"; the industrial art school movement (Peter Behrens, Josef Olbrich, Van de Velde); and, above all, the *Werkbund*.

Buildings were constructed to house these movements, exhibitions arranged, periodicals and yearbooks published. All had in view the establishing of an organic tie between creative forces and industry. In America, Richardson, Sullivan, and Wright struggled toward a solution. They recognized the creative spirit in the use of the machine brought about by bold and genuine inventors. In spite of that, industry kept on pouring out products, ignorant of its own creative potentialities, and for the most part following traditional prototypes developed by the handicrafts.

Out of the welter of rejection and approval, of demand and intuition, a principle slowly crystallized:

Not the single piece of work, nor the highest individual attainment must be emphasized, but instead the creation of the commonly usable type, development toward "standards."

To attain this goal, scattered individual efforts proved insufficient. There had to be a general concept; instead of solutions in detail, there had to be a serious quest for the essential, for the basic and common procedure of all creative work. In other words, all design had to be approached with the same questions concerning its function, material, production processes, social significance, etc. The recognition of this led to a significant mental attitude. Gropius declared that the designer has to think and act in the terms of his time. He wished to abolish the supremacy of intellectual work over handwork. He pointed out the great educational value of craftsmanship. "The machine cannot be used as a short cut to escape the necessity for organic experience" (Lewis Mumford).

In the Bauhaus, on the technically simple level of handwork, students could watch a product grow from beginning to end. Their attention was directed to an organic entity, and they were responsible for its entire production, as well as for its function. In the present factory process, the worker is directed only to parts of the whole, the ultimate relationships being known to him merely by description and illustration, not through experience.

Thus the manual training in the Bauhaus was not an aim in itself, but a means of education, and in part a necessary tool for the industrial model. This was the reason why the handicrafts were supplemented in the Bauhaus with the basic machines of various industries, enabling mass production.

The Bauhaus became the focal point of new creative forces accepting the challenge of technical progress with its recognition of social responsibility. It became the experimental shop, the laboratory of the new movement.

Gropius reintegrated artists into the daily work of the nation. The results were surprising. By uniting artistic, scientific and workshop training — with tools and basic machines — by keeping in constant touch with advanced art and techniques, with the invention of new materials, and new methods of construction, the teachers and students of the Bauhaus were able to turn out designs which had decisive influence on industrial mass production, and in the reshaping of daily life. The invention of tubular furniture, modern lighting fixtures, practical household appliances, new types of hardware, electrical contrivances, textiles, new typography, modern photography, and so on, were the functional results of this work.

Institute of Design, Chicago. The old Bauhaus in Germany was eliminated by the Nazis. Most of its members were scattered over the globe, to hold, nevertheless, important positions in education and production. Its spirit became the guide of progressive art education throughout the world, including the Institute of Design, Chicago, which trains students as designers of hand- and machine-made products in wood, metal, plastics, glass, textiles, stage designs and display, and for commercial art, exposition architecture, typography, photography, modelling, and painting. There the education of the designer has become correlated with architecture.

The Preliminary (Foundation) Course. The first two terms at the Institute are devoted to a *preliminary (foundation) course*, obligatory to all students. It presents the fundamentals of shop work, intellectual integration, the physical and biological sciences, modelling, drawing, lettering, photography, and music or literature. Its objective is spontaneity and inventiveness, to give the student a universal outlook, to make him conscious of his creative power. The method is to keep, in the work of the grown-up, the sincerity of emotion, the truth of observation, the fantasy, and the creativeness of the child. In the intellectual, as well as the emotional development of the youth, we have to learn to discriminate among the innumerable ways of expression which very often are distorted by an *imitation of experience* and by notions belonging to another generation.

The basic workshop of the foundation course is a great aid to genuine development. Here the student experiments with tools and machines, with different kinds of material, such as wood, metal, rubber, glass, textile, paper, plastics, etc., on a technical level which develops unhampered by conventions. No copying of any kind is employed in this workshop, nor is the student asked to deliver premature *practical* results. By working with the different materials he discovers step by step their genuine possibilities and acquires thorough knowledge of their structure, texture, and surface treatment. Also he becomes conscious of volume and space, fundamentals in three-dimensional design. Since, in the first year, every topic receives equal attention, he has ample opportunity to discover his preferences and inclinations before deciding on vocational specialization. In addition to the basic shop work, analytical, life, and geometrical drawing, lettering, modelling and photography, provide further media of expression. A class for sound experiments and building of musical instruments stimulates the auditory sense, and gives the most direct experience of the organic connections of handicraft and art. Intellectual integration furnishes the student with information about those intellectual topics which have a bearing on the understanding of his surroundings, and the world of intellectual activity. For his future task he receives further scientific education in

mathematics, physics, chemistry, bjology and physiology. These subjects are taught by scholars with special concern for co-ordination. Guest lecturers on the history of art, philosophy, psychology, etc., widen knowledge of contemporary topics and movements. After every term a trial exhibition of the students' work is held, and after an eight or twelve terms' course a final thesis is asked for.

The basic idea of this education is that every man is talented, that once the elementary course has brought his emotional and intellectual power into activity, he will be able to do creative work. This does not mean necessarily that it will be "art." Art is the expression on the highest level of a cultural epoch, a level which cannot be forced by any means. But comprehensive knowledge of materials, tools, and function makes possible for all work to be of such a high quality that a genuine, and not an accidental result will be obtained.

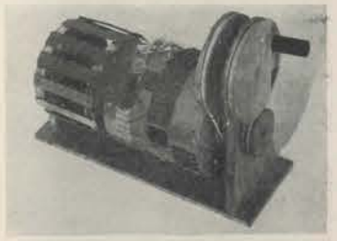
The Institute does not aim at the education of geniuses, or even of "free artists" in the old sense. There are too many "free artists" with minor talents and minor problems who have no possibility of making a living. The Institute does not want to add to their number. As members of society the students must learn to face practical as well as spiritual problems. If, then, by taking in all the practical and spiritual material offered to them during their training, some of them develop into "free" artists, this will be their own personal achievement, of which the Institute will be very proud. But as long as they are students, they must see themselves as designers and craftsmen who will make a living by furnishing the community with new ideas and products. This is the realistic basis of the workshop training.

Simultaneous design and architecture training. The specialized workshops. The Institute of Design offers five specialized workshops for those who successfully pass the first year's examination. These workshops specialize in:

1. Object design; product development
2. Textiles (weaving, dyeing, fashion)
3. Color (murals, decorating, wallpaper)
4. Light (photography, motion picture, light display, advertising art)
5. Modelling (glass, clay, stone, plastics, etc.)

All these workshops are grouped around the main goal: architecture. While in a special workshop the student simultaneously receives an architectural education ending with a Bachelor of Design degree; four additional terms will supply him with the special instruction needed for the Master of Architecture degree. These courses include domestic architecture, town and regional planning, landscape architecture, analysis of community service for schools, kindergartens, hospitals, recreation centers, etc. An architect with this education will be able to create buildings with a unity of interior and exterior. This means that domestic appliances, furniture, textiles, light, and color schemes will "match" one another and the whole. The new architect will know by his previous workshop training that only the closest collaboration of art, science, and technology guarantees an organic building, purposeful in both the physical and socio-biological sense.

II. The material (surface treatment, painting)



1. Rudolf Marwitz (Bauhaus, 1928). Revolving tactile drum with contrasting tactile values; materials arranged in rows.

Sensory training. Systematic work toward "mass production" starts, in the Institute, with a non-art approach. By experience with material, impressions are amassed, some often at first appearing unimportant. There is a further aim: knowledge of materials, of the possibilities in plastic handling, in tectonic application, in work with tools *and* machines — such as is never attained through book knowledge and traditional verbal instruction.

Basic sensory experiences — gained by these exercises — undergo development and intellectual transformation, and later are brought into relation to other experiences. It is not possible to skip any stage in experience, though it may sometimes appear desirable. From the first inarticulate experience, the whole of life is one continual growth. Therefore it is indispensable, in human development, to pass through all the stages of elementary experience in every field of sensory activity. Little by little man attains his own way of expression, and finds his forms.

Since the majority of people build up their world at second-hand, removed from their own experience, the Institute must often fall back upon the most primitive sources in order to guarantee an individual approach.

Tactile exercises. The physiologist divides the different impulses which reach consciousness as sensations into the *exteroceptive* (those set up by events in the outer world), *proprioceptive* (those coming from muscles and adjacent deep structures and from the labyrinth), and *enteroceptive* (those arising from the internal organs and viscera). But our daily language has retained the traditional "five senses," just as we keep the "twelve signs of the zodiac" and the "four humors." We speak also of a "sixth sense," which is possessed by people living close to nature, a special sense of orientation or of time. The sense of "touch," more than any other, may be divided into a number of separately sensed qualities, such as pressure, pricking, rubbing, pain, temperature, and vibration.

The student, in his initial exercises, studies materials principally by means of his sense of touch. He gathers a great variety of materials together, so that he may register as many different sensations as possible with them. He puts them together into tactile tables, which contain some related, and some contrasting touch sensations. After a shorter or longer period of experimentation, he is able to assemble these elements in such a way that they will correspond to a previously planned expression.

These exercises have nothing to do with scientific aims. We can understand them as a subjective test, which may be followed later by more objective scientific testing in a laboratory. Experience shows that the tactile exercises offer wide possibilities for useful ends. They provide a sound foundation for many-sided sureness in the handling of materials in technology, as well as art work.

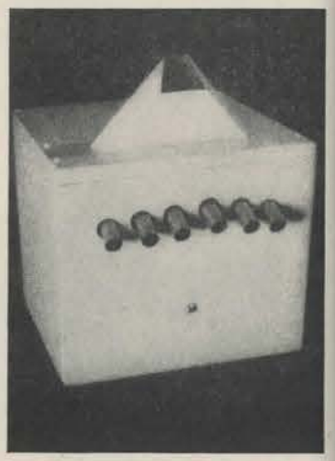
Some tactile charts make use, not alone of the tactile sensation of the fingers, but also of the muscles and joints. For example, the fingers can be pressed and caught between narrowly mounted curves, and they can rise up on bridges and fall down into valleys.

The form of the tactile charts was not prescribed for any problem, the only requirement being that the values to be tested should be clearly grasped through the slightest possible stimulus. This requirement led to fundamental differences in the individual solution.

The work turned in for these exercises showed not only a satisfaction in the right tactile values, but also an unconscious development of technical skill in the neat finish of the devices. There was a marked improvement in the later assignments, more difficult technically, bearing witness to a discipline not imposed but self-attained.

Among the tactile charts turned in, there was none that did not display an original idea. This was not the result of long preliminary instruction. The work was all done after the first few hours of discussion.

Since tactile values are registered purely subjectively, it appeared desirable to record individual reactions in "touch diagrams." These could be referred to again later on, thus checking any changes that might have occurred in the perceptions.



Tactile values, arranged purposely, can produce a new type of expression, just as colors or tones no longer represent single color or tone effects when placed in mutual relation. They are transposed into a meaningful structure, into an organism, which radiates force, and which has the power of releasing a certain mood, or even a new feeling of life.

How neglected our tactile education is was again demonstrated to me recently in a striking way in a conversation with the director of a training school of nurses, who spoke of the difficulties she had encountered in teaching massage. What I told her of the tactile exercises gave her the idea of introducing something similar into her own work, with the hope of helping her pupils to acquire greater refinement of touch sensation.

F. T. Marinetti, the leader of the futurists, in 1921 published a manifesto on "tactilism." He was a passionate advocate of a new kind of art, to be based on tactile sensations alone, and proposed tactile ribbons, carpets, beds, rooms, stage-settings, etc.

In the Institute, the concern with tactile values served to arouse and enrich the desire for tactile sensation and emotional expression, and did not have the aim of teaching a new kind of "art." This does not exclude, however, the possibility of works of art resulting from the deepening of experience and from the inspiration gained (especially in the case of the blind).

In the exercises of the different sensory training there was a marked difference in the behavior of the different races. This difference was also evident in the touch exercises with blindfolded eyes.

In the Institute we asked blind people to test some of the tactile exercises. Their response was most enlightening. It also suggested the possibility of tactile exercises in the education and rehabilitation of the blind.

Blind people enjoyed the testing of tactile charts. This was perhaps the first time that they experienced with their fingers something like a "picture." One stated in appreciation of the charts: "They are made for comfort."

2, a, b. Charles Niedringhaus (New Bauhaus, 1938). "Smell-o-Meter." For mixing six different odors six tubes are used and an electric fan blows the smell into the opening for the nose.

As all types of sensory sensations play an important part in our experiences the idea of an odor organ arose. Its greatest advantage was that it blended different odors in exactly given doses.

Drug stores might use such a device for offering sample perfume smells; so might tea and coffee houses, wineries, etc.

Experience with the material. Tactile charts represent an intensive psychological study of the material, and they increase one's assurance in measuring sensations. Moreover, there are many specific branches for physical examination, such as crystallography, metallography, colorometry, etc.

Proceeding from the results of such research, the scientist is able to foresee alterations and improvements in the working materials, and to give these changes a desired direction, to meet given requirements of strength, rust-resistance, temperature, and other characteristics, assuring the realization of many projects hitherto considered impossible. We rejoice today in a whole series of synthetic materials: plastics, for example, with their flawless, smooth, but still variable surfaces, with their extraordinary properties.

But we must still employ caution in their use. The results of experiments and guarantees, not to speak of advertisements, must be accepted with reservations, since industrial production is often not directed along the lines of actual needs, but for quick profits.

3. Structure of wrapping paper (microphotograph).

Terminology. The terminology for the different aspects of materials has not as yet been worked out with accuracy. In general, four terms are used:

structure
texture
surface aspect (or surface treatment)
massing (mass arrangement)

These designations are rather arbitrary, and are often interchanged in common use.

Structure. The unalterable manner in which the material is built up constitutes its structure. Each material has its own structure: in metals, it is crystalline; in paper, fibrous.

The microscope and microphotography disclose a new world. They reveal, in this age of haste and superficiality, the marvel of the smallest units of construction: our substitute for the longer period of time that primitive man could devote to observation.

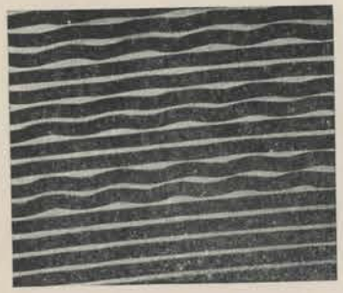
Airplane views are macrophotographs: "space compressors," an extension of observation. They reveal the large-scale relationships, as microphotographs reveal the smallest.

A photograph of structure often reveals the infinite richness of the material. The exact, sharply defined photograph is the best approach to a new education in materials, since its concentration of emphasis offers a quick, though an indirect approach to actual experience with the material. It gives the hurried person of today a stimulus to more leisurely observation of the object itself.

4. Texture of the skin of a man, allegedly 130 years old, in Minnesota.

The photograph of the old man is essentially a time-compressing view of the alterations in the epidermis: an airplane view of time.

Texture. The resulting outward surface we may call texture. The epidermis is an organic texture.



5. Surface aspect. Caruso's "high" c on a phonograph record. Microphotograph.

6. Massing (surface aspect).

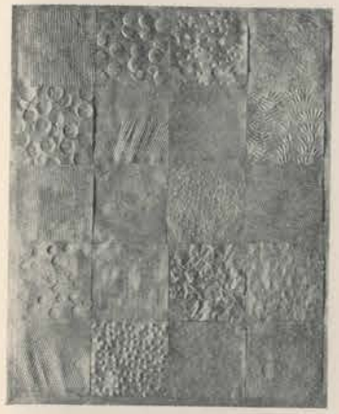
Surface aspect. Surface aspect (or surface treatment) means the sensorily perceptible result (the effect) of a working process as shown by any given treatment of a material. Such a change in the material surface through external factors may be brought about in different ways; in a metal bowl, for example, as pattern (hammer blows), or uniformly smooth (pressed, polished). Surface aspects may be due to elemental causes, such as the influence of nature, or to mechanical causes, such as machine treatment. The end result may be infinitely varied, according to the material and the force at work.

The definitions of structure, texture, and surface treatment are interchangeable in many cases. Take paper, for example: under a microscope it shows its structure; its normal appearance remains as texture; and its finish means its surface treatment. When we apply these definitions, we have always to decide the dominant quality.

Massing (mass arrangement). The fourth aspect of the appearance of material is regular, rhythmical, or irregular massing. This is the most easily altered aspect of the four. In the mass arrangement of surface units there are no organic relations, the whole often being not synthesis, but mere addition. "Massing" is often interchanged with "surface treatment," and there is no objection to treating "massing" (mass arrangement) as a "surface treatment," for the purposes of simplification. It is not our belief that, with our descriptions of structure, texture, surface aspect, etc., these concepts are adequately defined. But in education it is necessary to make an attempt at discrimination and definition, especially in a realm where none has been established.

That any phenomenon may exercise a psychophysical (sensory-reactive) action, which is registered by many people in a greater, by many others in a lesser, degree

is shown by this picture with the crowd of umbrellas. Everyone to whom I have thus far shown this picture has had to smile!



7. Gerda Marx (Bauhaus, 1927). Surface treatments of paper (a single material, different tools).

Exercises in surface treatment. 1. Surface treatment of paper with a free choice of tools (such as needles, tweezers, sieves) used in any desired way (pricking, pressing, rubbing, filing, boring, etc.).

2. Surface treatment of paper with a single tool (needle, knife, tweezers, or by folding, etc.).

3. Coloring different kinds of fabrics.

4. Surface treatment on paper and canvas with different tools (paint brush, air brush, etc.).

5. Surface treatment with color and brush on various materials.

6. Various surface treatments with glue (with graphite, sand, wood particles, sawdust, shavings, etc., scattered on the glue).

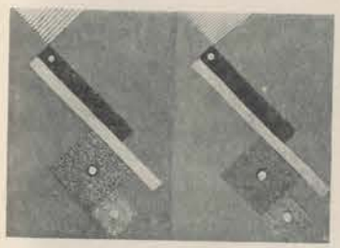
7. Surface treatment of various materials (wool, metal, wood, etc.).

8. Practical applications (making toys and the like).

9. Visual representations of structure, texture, and surface aspects, all the way from complete visual illusion to abstraction, by means of drawing, painting, and photography. The tactile values acquired by experience and transformed into exact visual representations can be thus evaluated, and applied in a wholly new manner.

Many people will perhaps not be convinced of the justification of such exercises until some practical application is pointed out. For example: book binders and manufacturers of wrappers (for chocolate, cookies, etc.) could get attractive "patterns" in this way.

But we are, in the first period of the teaching, much less concerned with such applications than with the fundamental relationship of man to material.



8. Hilde Horn (Bauhaus, 1924). A visual translation of values in the material (texture and surface aspect). Original montage and graphic representation.

Creative application. In the effort to recognize the conditions of structure, texture, and surface treatment, we often run into difficulties: cases of overlapping, or of alternative uses. But, in a general way, structure and texture determine the choice of working tools; surface aspect, on the other hand, is conditioned by tools, by the possibilities of external force.

Mere observations on the make-up of materials are of little value. Effective expression of such observations is gained only by meaningful application — a very different thing from *accidental* exploitation of one characteristic of the material. Purposive application alone can lead to the best treatment, that is, to inventions for household appliances, packages, book bindings, etc. The problem is, of course, to find proper ways of application, so that the importance of the elements will not be dominant, but instead happily absorbed by the best solution of the functional end in view.

The significance of these exercises lies in the close observation of the materials. Accuracy in representation was to be brought to the point of actual identity with the original when both were photographed. This problem is not to be confused with any artistic end. The exercises were solely to achieve a perfect coordination of observation and representation.

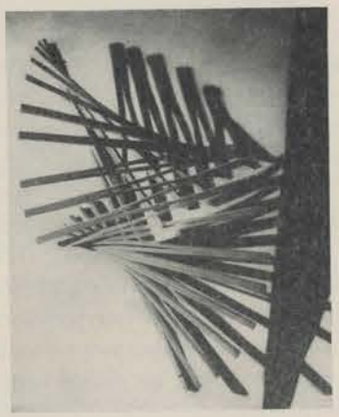
Photography is included in the preliminary course. Being itself a perfect instrument of exact representation it serves as means of comparison for the quality of manual craftsmanship. The illiterate of the future will be, we believe, the person who cannot photograph.

In the study of tactile values, as affecting structure, texture, and surface treatment, some of the students directed their efforts toward a definite goal, while others showed merely a receptive reaction. Some of the students made toys from their pieces of wood, while others left them only as material worked upon, to be looked at and touched.

A delightful result of these exercises with materials was the enthusiasm with which some of the students produced from a piece of valueless fire-wood various objects by intensive manual treatment. Often they rubbed and polished a piece of wood for days at a time, gaining in the end a lasting relationship to the material.

9. Paper cutting (The New Bauhaus, 1937).

These exercises show again the unlimited creative ability of the students. In a given framework everybody's solution is different.



10. Angelo Testa (Institute of Design, 1942). Experimental woodcut for wood springs.

Woodcuttings show the potentialities of the woodworking machines until now unknown. Solid pieces of wood can be changed into rubber-like elasticity, etc. The same principle can be applied to every other material and every other tool.

Education without traditional approach can perform miracles in the use of tools and machines. The students generally become so interested in their tasks that they do not find any difficulty in the use of machines. It is a status similar to that of children in kindergarten working with paint and crayon.

Biotechnics as a method of creative activity. The natural scientist, Raoul Francé, devoted himself to an intensive study of this problem. He calls his method of research and its results "biotechnics."

The essential part of his teaching is expressed in the following quotations:* "Every process in nature has its necessary form. These processes always result in functional forms. They follow the law of the shortest distance between points: cooling occurs only on surfaces exposed to cooling, pressure only on points of pressure, tension on lines of tension; motion creates for itself forms of movement — for each energy there is a *form* of energy."

"All technical forms can be deduced from forms in nature. The laws of least resistance and of economy of effort make it inevitable that similar activities shall always lead to similar forms. So man can master the powers of nature in another and quite different way from what he has done hitherto."

"If he but applied all the principles that the organism has adopted in its striving toward useful ends, he will find there enough employment for all his capital, strength, and talent for centuries to come. Every bush, every tree, can instruct him, advise him, and show him inventions, apparatuses, technical appliances without number."

As to the possibilities of using nature as a constructional model for appliances, we have statements by Galileo. Even in the earliest periods of cultural history, we find objects recognizable as the result of understanding prototypes in nature in regard to their functional value (not to be confused with a merely *ornamental* exploitation of natural forms).

But still it has more often happened that man, probing into the problem of rightly sensing and recognizing the unique properties of material (medium) + tool (machine) + function has, without studying prototypes in nature, hit upon correct solutions, later found to be in agreement with natural forms with similar functions. Such coincidences are valuable as laboratory data, but they should not lead to the assumption that a well functioning construction always has analogies.

The usefulness of biotechnics lies in a more conscious approach to inventions which are generally believed to be the results only of intuition. Fortunately, Edison's work proved that inventions can be greatly aided by the analytical method of science.

The basic law. In all fields of creation workers are striving today to find purely functional solutions of a technological-biological kind: that is, to build up each piece of work solely from the elements which are required for its function. But "function" means here not a pure mechanical service. It includes also the psychological, social, and economical conditions of a given period. It might be better to use the term "*organic (functional) design.*" Such design must even serve functions which could not be foreseen during the process of designing.

The responsibility. Technology has, in this respect, given an important lesson. Often the lives of thousands or hundreds of thousands of people are in the engineer's hands. In the construction of a machine, an airplane, a bridge, he can never overlook this. He assumes personal responsibility for his products.

Why is the responsibility for products whose use involves less danger to life held more lightly? Why, for instance, in the building of furniture or household equipment,

* Raoul H. Francé, "Die Pflanze als Erfinder" (Kosmos, Franckhsche Verlagshandlung, Stuttgart, 1920).

do we still let "personal preference" and applied art "standards" hold sway? Such "standards" are mainly a cloak for poverty of invention, as measured against organic, functional solutions. Goods intended for common use are neither sacramental vessels nor objects of contemplation. They must fulfill their functions first of all, and fall into a significant relation with their surroundings. Yet we often argue the question, with such expressions as "the designer must be allowed to use the free play of his imagination," and the like. But creative abilities can be turned into organically more correct channels than the purely ornamental or decorative to which "free play" refers.

The freedom of the creator. Naturally there are countless cases in which exact calculation of all the functional elements cannot as yet be made — in many cases, perhaps never. In every creative work there is a sphere in which a certain amount of freedom must prevail, where the definable function no longer determines, or at least not wholly determines form. In such cases an instinctive sureness, penetrating grasp, is required, and this is nothing more than a complicated interlacing of experience, imagination, and fantasy, processes going on in the subconscious.

There are other cases. The decorating of a wall, for instance, will remain a matter of subjective taste or creative instinct, until scientific research enters the field and determines the different needs, such as lighting, hygiene, and psychophysical requirements. Then, most probably, prescribed color tones can be used in certain places and certain rooms. For the present, our decisions in this field are rather arbitrary. We have scarcely a theoretical outline of the use of color.

We must guard against the pressure of the subjective desire to change objective forms which express function, "in order to make them more beautiful," by the addition of decorative elements. What could be the reaction, for instance, to a proposal to ornament the surface of a phonograph record?

Ornament. The creative application of the material, and of the production process clarifies the question of "functional" and "ornamental" form. In comparison with the recognition of organic relation, the discussions of yesterday — still carried on to some extent — as to "purposeful form" and "ornamentation" appear unnecessary. How naive is the fear of "cold intellectualism," of form expressing merely purpose, if we but learn to observe the forms in nature as meaningful according to purpose! Most people are not sure in judging decoration. Understanding becomes easier when we grasp the essence of an organic form, which is the crystallization of its function. Where a complete fulfillment of the functional need has been found, there is nothing left to ornament. Ornamentation almost always goes beyond the functional. In the past it was often a cult symbol, understood by all the people of the same civilization. Ornament was thus "surface treatment" with symbolic value; only later was it a surface treatment without its original cult meaning.

Sometimes ornament was also used to cover inexact execution. It was an afterthought, superficially added to the principal work; work that could not adequately meet its requirements was supposed to be given an increased value by decoration (e.g., wallpaper patterns, printed on cheap paper). A fancied increase in value was usually derived from imitation of an authentic arrangement, a mechanical repetition of a genuine historic form.

But not every symbol or repetition is ornamental. We need many symbols ourselves, traffic signs, the red cross, the eagle, flags, etc.

Repetition — i.e., a series — belongs to present-day technique. In it modern man recognizes, though often with a mental reservation, "the beauty of technology." His reservation is something like "beauty in spite of its technological origin."

Ornamentation was often subordinated to function. We find emphasis upon function in early times. Even ornament was made to serve a utilitarian function. The embroidery on Czechoslovakian shirtwaists, for instance, originated — as Professor Vydra has pointed out — by sewing narrow strips together in order to secure the required width of the shirt. This can be seen in the colorful raincoats of the Alaska Eskimos, too. They are made from narrow salmon skins, in alternating colors.

There exists also a kind of camouflage ornamentation, as in the decoration of wood. In Bavaria heavy planks on balconies — which, since wood continually contracts and expands, were in danger of cracking — were provided with lengthwise ornaments. A present-day analogy is laminated wood (plywood). Here the edges produce an ornamental effect, not "ornament." This effect cannot be called surface treatment, but, instead, "structure" or "texture," since it is the result of gluing layers together to prevent warping.

"Division of surfaces." The conception of "surface division" also belongs to the discussion of ornamentation. Its application, in architecture, for example, makes a wall appear thicker, smaller, or narrower than it actually is.

In the different aesthetic precepts of art there are many rules of correct proportion. Thoroughly understandable for past periods, to which the discovery of these precepts represented sincere and deep experience, they became mechanical guides to a conventional "art production," repetitions of formulas of the past, now emptied of all meaning. Formulae can never be the basis of creation. Real creation needs intuition on the one hand, and, on the other, conscious analysis, mature judgment, and a consideration of manifold aspects.

The criterion should never be "art," or "not art," but whether the right form was given to the stated function. Whether this ever will be called "art" is of secondary importance.

Composition, construction. Composition and construction are aspects of the same problem. Composition is the product of the highest subjective evaluation of elements and their relationships. This evaluation may even, in the course of the work, be changed by the introduction of new elements, which result in alteration of the total composition.

A construction, on the other hand, strives toward a known objective, through predetermined technical and intellectual relations *at every point* of its existence. Any alteration in the course of execution invalidates the previously organized distribution of forces. Construction therefore demands — as compared to composition — a plus quantity of knowledge. This does not mean that intuitive inspiration is eliminated.

Tradition. It is unfortunate how often tradition, never re-examined, is honored as an unerring guide to what is beautiful and what is right.

The ideal of yesterday has become an aesthetic formula, a source of pseudo "experience," for the new generation. The official seats of learning — universities and colleges — must accept the responsibility for this error.

The same failure to think and work independently is unfortunately exhibited today in every domain, as much in handicrafts as in machine production. It is, to be sure, less

dangerous in the handicrafts. The number of objects produced is relatively limited; but the machine, with its boundless output, is terrifyingly fecund. It spews out — in "beautifying" everyday objects — stereotyped decorations on thousands of commercial articles.

Engineering and technical skill have freed themselves from formalism somewhat more. Engineering products are designed mainly on the basis of functional requirements. This fact is remarked because the standard of "classical" beauty was long firmly fixed in the heads of machine builders as well. Machines built during the last century were adorned with Doric columns, Corinthian capitals, and baroque festoons.

Art. Our existence seems excessively burdened with accretions from the past when compared to a new plan of life, in which all creation springs from inner necessities.

Even in its seeming isolation, the experience of art as the thermometer of necessities is indispensable for society. The true function of art is to be the graph of our time, an intuitive search for the missing equilibrium among our emotional, intellectual, and social lives. Art is the most intimate language of the senses, a direct linking of man to man.

What Sigmund Freud had to say about these relations is interesting: "Only in one field has the omnipotence of thought been retained in our own civilization, namely, in art. In art alone, it still happens that man, consumed by his wishes, produces something similar to the gratification of these wishes, and this playing, thanks to artistic illusion, calls forth effects as if it were something real."

On the other side, Piet Mondrian, one of the great painters of our century, pointed out:* "This . . . brings us, in a future perhaps remote, towards the end of art as a thing separate from our surrounding environment, which is the actual plastic reality. But this end is at the same time a new beginning. Art will not only continue, but will realize itself more and more. By the unification of architecture, sculpture and painting in their highest development, a new plastic reality will be created. Painting and sculpture will not manifest themselves as separate objects, nor as 'mural art' which destroys architecture itself, nor as 'applied art,' but, being purely constructive, will aid the creation of a surrounding environment not merely utilitarian or rational, but also pure and complete in its beauty."

The art "isms." The problem of the creative worker is mainly one of finding elements that are adequate for the content. Reflecting all the movements and aspirations of his time, the creator attempts to express himself with the means of his own day. This is the common denominator of the many art "isms" which have sprung up in the last hundred years: naturalism, realism, impressionism, pointillism, neo-impressionism, expressionism, cubism, futurism, suprematism, neo-plasticism, purism, constructivism, dadaism, surrealism, etc.

Nevertheless, for the majority of observers it is scarcely possible to distinguish among the dozens of art "isms" — even in their classifiable, rationalized and historical phases — because this common denominator is not known to them. So it seems to many people that each picture, piece of music, or poem, demands for its comprehension a deep-lying philosophical sub-structure: a brain-cudgeling, rather than a direct surrender to its expression.

* "Plastic Art and Pure Plastic Art" (The Documents of Modern Art), Wittenborn and Company, N. Y., 1945.

Laden with false expectations, people want to "understand" everything at once, instead of first clearing the channels of experience. It is, for example, a most informative fact that the arts, as well as the sciences, strive to establish a better control of our environment through more related research and representation, through clearer co-ordination of these with daily life. Thus the observer must first learn to acknowledge in his own life the ruling biological principle, and to strive, in spite of social restrictions, to let it have its way. He may thus be in a position to recognize the same principle in its most varied aspects and manifestations. It will then be easy to take the step to art itself; and art forms and art "isms," which at first appeared complicated, will order themselves in an organic relation.

An example. The native strength of an approach through experience — unfettered by formulas — can be demonstrated in the work of any sound artist, by the following example of expression rising from within.

With the background of experience with materials, suggested as preparation in the first part of this book, such an example can become a stimulus to bring the reader closer, as the example, to the work of cubism.

And if cubism can be made clearer, it will then become an easy task to follow a line and understand all other art "isms," for they have astonishingly much in common with cubism.

Cubism related to space representation. Picasso's work is suitable for introduction at this point, because — especially at the beginning of the cubist period — the relation to elemental experience of materials, to tactile values, and to surface treatment is particularly graspable in his work. His intuitive comprehension of this field, on the visual side — though today already a matter of historical record — was full of the unexpected, the fresh, and the lively. What seemed in him only yesterday bizarre and senseless, now reveals itself as an ingenious paraphrase of our changing outlook on materials and space-time.

There is no doubt that the development of occidental painting can be approached from many points of view. If we choose one, e.g., the visual representation of space, i.e., the creation of spatial illusion on the picture-plane — then the cubists and post-cubists belong to the revolution which changed the terms of the older representation of space, terms which were based on different linear rhythms, color, size differences, surface divisions, linear and aerial perspectives, isometry, light and dark, etc. The cubists introduced a new structure, through the organization of parallel planes.

About cubism. The following discussion cannot deal exhaustively with all the cubists. In their work, besides the problems mentioned here, there are countless others, having their origin partly in their way of looking at the world, partly in their material, and partly in their intuitive understanding of the problems of their time. It is not necessary, nor will it be possible to set it all down in words.

Cubism was originally a nickname intended to discredit Braque, Picasso, and his comrades. The picture which brought about this "witty" designation contains, in fact, cubic figures. Complicated objects, richly varied in appearance, were reduced to geometrical elements. But in its later development, cubism had nothing whatever to do with cubes. Its work is better characterized as the resolution of the external world into its elements, into dissected and newly organized planes, which in turn produced a subtle but very definite articulation of the picture's surface.

The first phase of cubism (Picasso, Braque, Delaunay, Gleizes, Gris, Léger, Metzinger). It is highly probable that, among other social and economic origins, cubism had a real beginning in the expression of Cézanne: "Tout dans la nature se modèle selon le sphère, le cône, et le cylindre; il faut s'apprendre à peindre ces figures simples, on pourra ensuite faire tout ce qu'on voudra" (everything in nature is modeled on the sphere, the cone, and the cylinder; we must teach ourselves how to paint these simple figures, and then we can do whatever we wish"). Picasso accepted this dictum, together with his companions, Braque, Delaunay, Gleizes, Juan Gris, Metzinger, Léger, etc. They experienced the world "geometrically." But soon a noteworthy change was introduced, which seemed to involve the denial of pleasure in these geometrical forms. Pictures were painted in which objects, though related to geometry, were represented in distorted shapes.

What was happening? Order, which had been extolled, was rejected for its opposite. But only seemingly so. The beauty and sincerity of a neat, crystalline world was to become even more evident from the reversal. This is one side of the story.

Looking back, it can be suggested that something like the following may have underlayed this development. In our environment there are stereometrically exact objects: bottles, goblets, bowls, musical instruments, etc. But since they are all around us, the objects of daily routine, nobody any longer observes and enjoys their beauty. So we must make the beauty of the exact clear, by an artificial distortion, leading to a conscious rediscovery of their immaculate beauty in the mind of the observer. There starts something new, too. The illusionistic representation of objects, with the help of the fixed renaissance perspective, gives way to a representation which works with simultaneous views of the object; i.e., the object is seen in frontal elevation, from above, from profile, and from three-quarter profile. The "distorted" object on the canvas is the intuitive amalgamation of these different points of view. Another method shows clearly such a process of simultaneous viewing. The objects are flattened, as they would be if they had been pressed between two plates. In this way the spectator can see more of them than from a "normal" fixed viewpoint. The lighter and darker shading of surfaces can be understood as a means for discrimination in percepting each viewpoint, and at the same time as spatial articulation — back, forward, oblique — of the pictorial space of the picture-plane. This latter led the cubists to a more conscious analysis of their new spatial expression, which became the basis of a new visual orientation.

But Picasso exercised not only a pedagogical function. He is also — and first of all — the creator of organic working processes. The form of his picture is dependent equally on the application of materials, and on his tools. Thus, for instance, "La Table" (1910) is a drawing with clearly legible stroke values of pencil on paper. It seems almost the result of automatic action. One might say the pencil had created everything from its own impulse, *by virtue of its own unique quality*. (One could give similar descriptions of every cubist picture, whether it was executed in wash, watercolor, oil, or in other medium.)

This is what we may call *objective* surface treatment: the rediscovered values of materials and of tools, which, in the later cubism — which was detached from representational aims — also work in themselves and for themselves; not as a naturalistic copy of the external world, or as an attempt to give the illusion of actual materials, but as material values, actually presented through "surface treatment."

Surface treatment in painting. The problem of surface treatment in painting is of

long standing. The renaissance artist exploited his material and tool values as best he could, in the interest of the complete illusion of naturalism. The essential thing he wished to bring to life in his picture was not only that color and contour, plane and line, and their values of direction and position, are capable of releasing a network of sensations, peculiar to these elements alone, but also that a story was to be narrated in color: an accurate copy of the external world, made comprehensible through the relations of three-dimensional objects. The impressionists were the first to rediscover, as essential components in painting, color and light within their own potentialities. No doubt this had been known to painters of other times; it was utilized to a great extent by the Florentines, especially Botticelli. He used an almost pointillist technique, painting over different colored layers with short strokes in the complementary colors. With this technique he overcame the rough material effect of the pigment, and achieved a sublimated light sensation. However, in his case, it was an intuitive use of optical laws and psychophysical effects, not a goal, as it was with the impressionists.

The crux of the technical problem of the impressionists was to bring colors to their elementary intensity, to the point of translating color into light. They remembered that the atmosphere affects colors, either by dulling them or making them brighter, so that light must be represented by vibrating color schemes. They painted therefore no homogeneous surfaces; but each surface was dissected to small parts, and resolved into different values of tone, hue, and brilliancy. Soon after, experiments were made (van Gogh) with relief-like application of the pigment, which permitted a breaking up of the color, if light was falling upon it (through the high-lights and shadows of the brush strokes). The result was an intensification and a heightened liveliness of color.

But since this could never be light itself, but only a translation, each individual effort had a very personal character. Surface treatments were a necessary "evil," which had to be mastered, if *light* was to be fixed on canvas. Brush and liquid color, spatula and thick pigment masses were not allowed free play, so as to produce their own quality. They were merely the accessories in the securing of "atmospheric" effects. The real discoveries in surface treatment thus came about almost by accident, in the search for the best method of representing light.

These discoveries passed in large measure as personal, almost patented processes, without recognition of their objective visual value. Even the futurists clothed their new content — which was impression of objects in motion, or the simultaneity of occurrences — in the old (in part pointillist) technique (Severini). At the same time the cubists came on the scene with an "objective" surface treatment. They found out what it means to accede to the requirements of the material, instead of subduing it. They observed that washes with a brush, or washes with a pen, and watercolor, tempera and oil in various techniques must be handled differently, and that this "giving in" became a dynamic stimulus toward a new content.

The linear perspective discovered in the renaissance could give a statement about the object only from one fixed point. Every detail of the representation was valid only from the unalterable position of the first spectator, the painter. The same notion decided that sculpture must have a "best" side; i.e., be viewed from a fixed point. This gave a subjective, rather arbitrary definition of the "object." The cubist felt the need of a more essential representation of the object's manifold aspects. Thus he began to peel off the surfaces of the object, to disintegrate it, in order to become fully acquainted with its structural elements.

11. Pablo Picasso, 1913. Still life (collage).

12. Pablo Picasso, 1913. Portrait (oil painting).

The guitar, the pipe, the bottle, the glass, repose on the table (Fig. 11). Picasso observes them singly, for the moment without regarding their relations to each other. He is not restrained, by an artistic formula, from experiencing them directly. He cuts them apart, looks into their insides, and lays the dismembered parts parallel to the plane of the canvas, one beside the other, giving a cross-section, an oblique section, a view from the side, and a view from above. He pulls the leg off the table, and sticks it on top, so that everything — no part more important than any other — lies side by side, showing its manner of being, without concealment, its "objective reality."

The wall of the room in which the table stands is covered with wallpaper. A piece of that wallpaper is attached to the picture; no more concrete manner of denotation exists.

A newspaper is lying on the table. It would be a superfluous effort to attempt to paint words exactly like the printed ones; a piece of the newspaper is glued to the picture. Shadows cannot be glued on; but since he has not yet wholly freed himself from academic naturalism, and still adheres moreover to the impressionistic principle which allows no monochromatic representation of surfaces, the pieces of paper glued on are smeared with charcoal, in order to represent shadow.

Picasso's analyses of the pictorial space were the outgrowth of his efforts to attain a precise rendering of his experience of objects. The dismembered parts are placed one behind the other, to endless depths, many times again woven together, so that they interpenetrate one another, but always in the manifold variety of an exciting visual arrangement, creating a richly articulated space.

The next step: the "shadow" becomes an actual shadow, the result of sticking real objects on to the surface. The object must be grasped in all its attributes. Thus the relief in wood, 1913, is made. The guitar and the other objects are actual pieces of wood nailed on the surface; they produce real shadows — which enliven the surfaces. With light and shadow, as the impressionists demanded; i.e., the "pictorial effect," the *peinture* quality, is gained without help from the breaking up of colors, and painting them with a brush on the picture-plane.

Here is the parting of the ways. A step further, and the picture, and with it the effort to fathom the being of an object by the graphic method, would disappear. The next treatment would have to be: to mount the object itself, in whole or in section, in its original size, on a board — i.e., actually to let everything simply stay on the table.

Thus Picasso's concern for the pictorial possibilities of expression brings him back to the plane, to the flat surface.

Now with complete abandon he tries doing everything possible to the surface with pigments. Although he continues to paint objects, still lifes, portraits, the "subject matter" becomes more and more a side-issue (Fig. 12).

His discoveries of surface treatment overreach one another. He uses the brush, the palette knife; he combs or scratches the pigment; he mixes it with sand, cement, or graphite. He introduces new materials: corrugated cardboard, wire mesh, etc. Anything — in order to attain the shimmering color experience of the material. The subject is disregarded.

The structure, texture, and surface treatment values first played a great part in the work of the cubists (Picasso, Braque). They were later taken over by the futurists, and still later by all the other "ists." They became, for instance, the stimulus for a new typography; they affected photography, advertising, the motion picture, the theater, and have had many repercussions on our whole life today.

At this stage of cubism, the titles of the pictures are often misleading. They incite the observer to look for the meaning of the work in its point of departure in the external world, a point which is usually submerged by the process of formulation.

The picture-plane gives way here, in fact, to the laws of pictorial arrangement crystallized from the relationships of color, of chiaroscuro, of position, direction, of proportions of lines and surfaces, and of surface treatment.

"Dictionary" of cubism. Today, more than three decades after the start of cubism, one is able to enumerate its characteristic features almost as a "dictionary." This shows, by the way, that the technique and spirit of photography directly or indirectly influenced cubism. Cubism employs the following distinctive means:

1. Distortion.
2. Twisting of objects: the profile simultaneously turned *en face* (the pipe, tableleg, and glass look like pressed flowers).
3. Sections: using parts instead of the whole.
4. Shifting: dislocation of parts. Refraction of lines, and breaking continuous lines.
5. Superimpositions of different views of the objects.
6. Introduction of geometrically exact lines, straight and curved.
7. Change of positive-negative planes or lines.
8. Many forms in one. Pluralism. A contour refers to several forms.
9. *Objects:* Letter types, envelopes, table, tableleg, guitar, violin, fruit, fruit bowl, glass, bottle, face, dead bird, fish, panel, playing card, pipe, tobacco wrapper. (The atmosphere generated by these objects is that of the Paris café.)
10. *Materials and technique for surface treatment:* Corrugated cardboard, wallpaper, marble, grainy wood, sand, newspaper print, marble dust, wire-mesh, combing, sanding, scratching of the pigment.

Now the picture-plane itself begins to be the subject for analysis. It is divided up. It is conceived as a rigid body whose secret the artist attempts to reveal by means of line and plane organization, visual illusion, color, rhythm, geometry, etc. The picture-plane is activated by cutting and penetrating it, by turning it about and pulling off its skin.

The artist dispenses even with the relief-like sand, graphite, combed, and other surface values which automatically intensify colors by the simultaneous existence of shadow and high-light. These values yield place to an illusionistic treatment, a patterning of surfaces, which comes from a subtle distribution of differently colored light and dark spots and features. The relief-like treatment is thus transposed into a plain surface pattern.

The practical consequence of the cubist's discoveries could not at first be properly appraised. Today we can see that through them space relations, materials and surface treatment have experienced a vitalization which, in its application to our daily life (even if with a superficial and half-intelligent application), has shaken us out of a visual lethargy.

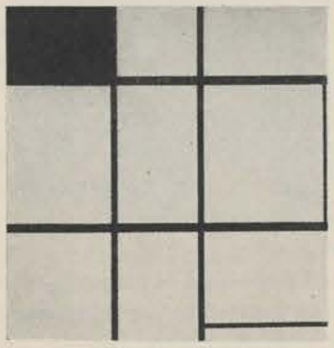
A brief summary of the present visual problem. The development of the different media and their inherent capacities for creation of pictorial space might be traced in just the same way in the other painters, who have carried forward the work of the cubists. They expressed similar ideas of a new space reality — and independently of all claims and associations with nature; in other words, they did not use nature as the point of departure for their work.

13. W. Kandinsky, 1913. Improvisation No. 30 (warlike theme).

Abstract painting. The problem of pure color as a means of expression was introduced by the post-impressionists (Cézanne, Seurat, van Gogh and Gauguin) and the expressionists ("Brücke," Munch, Rouault). But already the impressionists and, more consciously, Cézanne and the fauves (Matisse, Derain) used color for its psychophysical quality, and for space-representation. Cézanne's pictures can be seen as exact and vital representations of nature which are created solely by advancing and receding colors. In making such spatial structures, Kandinsky went further. He used color as an existence of its own, creating with it a new visual tension. This tension is measurable, to a certain extent, in the warmth and cold, nearness and distance, lightness and heaviness, centrifugal and centripetal energies, and lux-values of the color (Fig. 13).

It is interesting to note that not one of the new discoveries can be seen as an isolated fact. All are built upon a predecessor's work. For instance, some of the early Matisses and Kandinskys can be regarded as "close-ups" of a detail of Cézanne's pictures.

Almost the same things can be found in neoplasticism, suprematism and constructivism — in relation to cubism; especially if we look at them from the viewpoint of space. Cubism was already a new approach to space, expressed through revolving objects, a new conception of pictorial space, which included the elements of motion. This was continued more consciously by the new painter generation.



14. P. Mondrian. Composition, 1934.

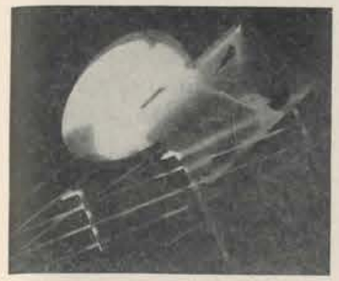
Neoplasticism; Suprematism; Constructivism. With a more integrated approach to every event in life, the neoplasticists, suprematists and constructivists have clearly understood their materials, and have tried to organize them. They have departed entirely from the traditional desire to mirror nature. They have tried to use the visual means of expression for the projection of order and harmony, without that distortion of the unique meaning of visual means which is inevitable if the means are obscured by associations with the objects of the external world. The work of renovation is a new evaluation of color, its optical energy, visual illusion and after-image, which are the means of a new kinetic space-time rendering.

Besides an intensified intuitive search, this work has resulted in all-embracing structural relations, in place of the usual psychological associations, i.e., sentimental values. The new approach has tried to eliminate all such values in favor of pure color relationships. It has stood for direct expression, as well as for the value of seeing everything as related. This has become the activating force in the construction of a new life.

Beginning with the French Revolution the idea of truth was one of the fundamentals of XIX century ideology. The "truth of the two dimensional plane" belongs to painting. This is perhaps one of the reasons why the romanticists and later the impressionists started to paint entirely flat without the usual modeling of objects.

Mondrian's significance is that in order to enjoy the really elemental color sensation, he reduced the color of his palette to red, yellow and blue, the subtractive primaries; that he sacrificed his knowledge about the mixtures of colors, except tinted white and black. He even gave up the use of any surface treatment, which cubism practiced with great delicacy. He put out of action the age-old psychological and apperceptive meaning of color and changed them over into pure relationships of spiritual values. With his puritan approach and almost unbelievable simplicity he created a spiritual greatness to which we can hardly find a corresponding case in the history of art.

One of the aims was to create a new space, which was to be produced through the relations of the elemental material of visual expression — a new space created with



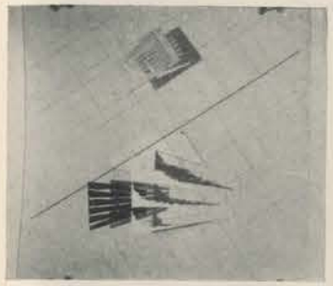
15. Photographic surface treatment by light: a "photogram," made without a camera (by L. Moholy-Nagy).

This is the recording of light as it hit a projection screen — in this case, the sensitive layer of the photographic paper.

light directly, subordinating even paint (pigment) — or at least sublimating it as far as possible. The first steps toward such a concept were made intuitively by the constructivist painters. Their practice reached a technical first stage in the airbrush technique and in the photogram (Fig. 15). On polished surfaces, metals, synthetic materials, etc., there were sprayed very thin, iridescent, flowing layers of paint, to which the reflecting layer underneath gave an ethereal, fluctuating appearance (Fig. 16).

The use of transparencies, the ability of the colors to change with subtlest differentiation through a nearby color, etc., enriches considerably the scope of new space relationships.

These actual reflections and mirrorings bring the surroundings into the picture, attaining through this a pliability of surface which has been striven for ever since the first days of impressionism.



16. L. Moholy-Nagy. Transparent Rho 50a (Construction on Rhodoid). 1936.

The new plastics allow a new type of visual expression to develop. Glass-like sheets, pliable, can be curved convex and concave. They can be perforated so that light and pigment will be fused into a new unity. Artificial light sources (spotlights, moving lamps) can continuously change the composition. This kind of picture is most probably the passage between easel painting and light display, a new type of moving pictures.

The surface becomes a part of the atmosphere, of the atmospheric background; it sucks up light phenomena produced outside itself — a vivid contrast to the classical conception of the picture, the illusion of an open window.

This stage marks the close of impressionism; it represents the mastery of the surface, not for atmospheric, but for plastic, spatial ends.

The final simplification of the picture.

The projection screen. Here is to be found the interpretation of Malevich's last picture — the plain white surface,* which constituted an ideal plane for kinetic light and shadow effects which, originating in the surroundings, would fall upon it. In this way, Malevich's picture represented a miniature cinema screen.

If the projection is directed on a film sensitive to light, a photograph or photogram results (Fig. 15).

It seems — from the standpoint of technical development — that a picture painted by hand is surpassed by the physically pure, "unblemished" light projection.

Ever since the invention of the motion picture, painters have concerned themselves with this problem: projection, motion, interpenetration of color and light. Photography is doubtless a bridge.

* Malevich, the great suprematist painter, at the close of his experimental work, executed a picture that was merely a white canvas with an equally white square painted on it.

Cubism utilized photography in its study of surface values. Photography, in turn, awoke to the possibilities of its own province after a decade of cubist experiment. This applies also to the use of simultaneous views in motion pictures, foreshadowed in cubism. Simultaneous action was obtained, in cubism, by presenting at the same time the object from above, from the side, and in cross-section, a juxtaposition and superimposition of these views, in contrast to the postposition of cinema projection.

17. Balla, 1913. "Speed."

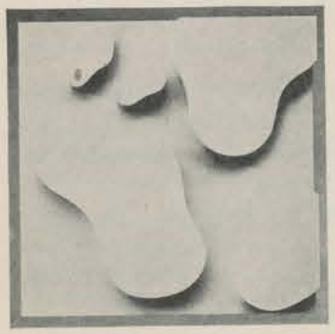
Futurism also took up problems, essentially of a cinematic kind, long before the motion picture began to. We might characterize futurism as a superimposition of the object in a sequence of linear movement (Fig. 17), while cubism is the rendering of the objects as if they were rotated in space.

This conception is not against hand painting, so far as it meets individual or educational needs. Such manual methods will be, however, less effective than the mechanical methods already available.

A psychological experiment made at the University of Wisconsin in Madison gives a clear explanation of how color is able to change sizes. Black, white, yellow, green and blue cubes of the same sizes have been shown each beside the other. The white cube appeared to be the largest, black to be the smallest. Yellow was larger than green, and blue was smaller than green. The same phenomenon can be expressed with other words: the white cube being the largest appeared to be the nearest to the spectator, the black being the smallest appeared to be the furthest away from him.

This means that if a painter should use these colors he would be able to change their experimental characteristics with certain manipulations. Indeed, the constructivists' work often offers the example that black moves in front of white, etc. The after-images and the subjective changes in the neighbor colors, these most interesting phenomena, were until now little observed. However, they are valuable means to the painter's spiritual craftsmanship.

The thorough study of children's work will bring greater clarification in this matter. When children paint they always operate with a kind of "color automatism" e.g., they answer to every color or color group almost automatically with the complementary; or they use colors dependent on after-images or on "psychological mixtures."



18. H. Arp, 1935. Configuration.

The play of refracted light. In the continuation of this work we undoubtedly must come to the manipulation of moving, refracted light (color); we must "paint" with flowing, oscillating, prismatic light, in lieu of pigments. This will allow us a better approach to the new conception of space-time.

These means existing today — polarization, interference of light, and the control of artificial sources — offer an opportunity not to be underestimated, even if for the time being they fall into the hands of the creative artist only by chance or indirectly — mainly in work with electrical advertising signs, or in stage settings.*

* The reader may easily reproach this presentation of the problem of visual creation for one-sidedness, since art "isms" important for the history of our times — such as dadaism (Arp (Fig. 18), Schwitters, Duchamp, Picabia, Grosz, Hausmann), purism (Jeanneret, Ozenfant), surrealism (Chagall, Klee, Ernst, Man Ray, Masson, Miró, Margritte, Dali) — are neglected. But I see the problem of "painting" as one of autonomous visual creation, and not as the illustration of a doctrine, e.g., psychoanalysis, and thus have to limit myself to such examples as will clarify this special position.

III. Volume (sculpture)

The general position. In the good middle-class home of yesterday, pictures and statues were tokens of refinement. Art was envisaged in an external way, as the height of all human attainments — just as technology is today idealized by many people. There was nothing more in this than cultural snobbery. The demand for "art" — as for soap — became a scale for measuring the cultural standing of a nation. The pictures were enlarged decorations, or illustrated stories, the sculpture, for decades, cheap plaster casts or bas-reliefs, often sporting trophies.

Public monuments? The sculptural form and its site were decided by politicians and the traffic police.

But while many people in general slowly succeed in establishing some sort of relationship between themselves and painting, because of its subject and its attractive color, sculpture stands isolated. Most people look at it as outsiders, and cannot imagine it entering into their experience. They usually see in sculpture only a poor "story." Deep feeling for plastic relations, and their biological and social implications remain unexplored.

This state of affairs led a whole generation to the rejection of "art." They even denied that there was justification for any form of pictorial or sculptural expression.

A reaction set in when it was recognized that this attack was directed, not against the existence of the creative worker, but against the hypocritical attitude of a society which preached "art," but deprived its members of its experience.

The way was smoothed for a new development, which brought with it a radical alteration in pictorial and sculptural aims. The old notions of painter and sculptor cracked; their social aims suddenly contained much more than the words had implied in previous use and understanding.*

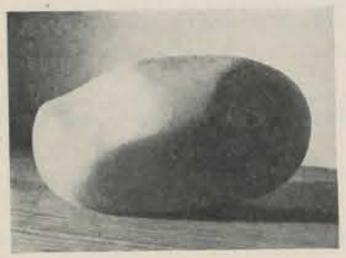
Fundamental attitudes in treating materials. Sculpture can be approached from different viewpoints: those of the tool, material, form, volume, size, proportion, positive-negative, setting, and expression. The most natural appreciation comes from the way it is made.

* Since the first edition of this book a fundamental approach to sculptural problems has been made by C. Giedion-Welcker in her book, "Modern Plastic Art" (H. Girsberger Verlag, Zurich, 1937).

If several people are handed a block, a piece of wood, for example, certain tendencies will appear in their way of handling the material.

At first the worker respects the homogeneity of the block. He proceeds cautiously with it, almost respectfully. He examines it, feels it all over, estimates its weight, calculates its make-up, its dimensions, and often finds it sculpturally expressive because of the fine contour and formation of the original shape.

Then he starts — in the passive mood of a spectator, or in the active mood of an experimenter, according to his temperament — to work on the block with a tool, his purpose at first not being evident, but becoming clearer as he proceeds. As he goes on, he assumes with amazing keenness the role of a passionate and meticulous artisan. He becomes better acquainted with his material and his tools. He notes the relations between full and empty, between round and angular, dull and sharp, small and large, raised and recessed. He invents methods, discovers new implements, dares to proceed more drastically: to make huge indentations, holes; he penetrates deeper and deeper into the block, producing in this way negative volumes ("hollow spaces"). Such step by step articulation of the material is the basic departure of all creative work. But to articulate, one must thoroughly know the means. This only can be achieved through practical work.



19. Edna Morse (The New Bauhaus, 1937). Hand sculpture in wood.

Hand sculpture. When the student finishes his tactile chart, in which he discriminates with his fingertips the different qualities of touch sensation, he has to make a hand sculpture (Fig. 19). Through this he registers the functions of the hands, that is, to catch, to press, to twist, to feel thickness, to weigh, to go through holes, etc. The result is manifold: the student learns more intensively the different materials; he uses more skillfully his tools and machines; and he starts to think in the relations of volumes. Hand sculptures are nearest to the timeless forms of any age because they express the pure functions of the hands. They often evidence a likeness to the free shape sculptures of Hans Arp, Henry Moore and Barbara Hepworth.

Sculpture is volume creation. When a man faces his materials, experiencing them more and more, it becomes a factor in his thought that sculpture is the best form — the original form — for taking possession of volume. Compared with volume, everything else, the making, the weight, structure, representational idea, likeness, expression, proportion, rhythm, consistency, and color, is secondary, belonging more to details. They do not count primarily in the grasp of volume, or, therefore, in the plastic expression of sculptural values.

It must be observed, however, that this intensive method of conceiving volume had, in the course of cultural history, been more and more superseded by an intellectual conception, that of likeness to the objects of the external world. Content overrode form, and description supplanted grasp.

The five stages of the development of sculpture from the standpoint of treatment of the material. In working with the material, and in discovering the volume relations as they become more and more clear, we may set down various stages of plastic development — not merely for an individual, but for the history of culture as well.

These stages are:
1. blocked-out
2. modeled (hollowed-out)
3. perforated (bored-through)

} sculpture

20. Constantin Brancusi, 1926.
The fish (polished bronze).

In opposition to the aesthetic rule of the past that a sculpture must have a "best" side we postulated the idea of the sculpture in the round. The sculpture in the round shows the same quality of all sides in a perfection and balance of its shapes, masses, linear flow, etc.; thus Brancusi placed "the fish" on a mechanically revolving base.

4. equipoised
5. kinetic (moving)*

} sculpture

This development may be summarized as: from mass to lightening of weight, from static treatment to movement.

These explanations refer, in general, only to sculpture in the round, that is to say, to self-sufficient sculpture, that which finds its justification in itself, fulfilling its own laws — like pictures — without relation to architecture.

The first stage. The piece blocked out:

A material block, which shows its mass in plain, untouched volume (like the pyramids, and other natural monuments and meteorites, the Caaba at Mecca; crystalline blocks, or prisms) (Fig. 20).

21. Alexander Archipenko, 1936.
Sculpture.

The credit for the first conscious use of concaves in sculpture — to replace saliencies — is due to Archipenko. In using this principle, he exploited the well-known optical illusion, as shown in a relief matrix (intaglio); the hollowed out (negative) portions

The second stage. The modeled (hollowed-out) block:

Small and large mass (volume) relationships of salient and sunken, positive and negative, round and angular, sharp and dull (Fig. 21).

* Since the publication of this book a new English term has been introduced for "kinetic" sculpture, that is, "mobile."

of the casting model appear in certain light as raised (positive). His attempt leads the observer, by its evident deviation from the customary naturalistic treatment, to a realization of the elementary possibilities of the positive-negative relations.

The third stage. The perforated (bored-through) block is the third stage. After mastering the relations of various degrees of positive and negative volume, an intensive penetration of the material follows, creating contrasts. The completely perforated sculpture is a heightening to the very limits of hollow and full (Figs. 22-26). How prevalent the old-fashioned idea of the block still is, is shown by the completely perforated sculptures of Jacques Lipchitz (Fig. 25). He assures the visitor that the sculpture is not assembled, but is "drawn" from a single piece.

22. Auguste Rodin, 1900. Purgatory.

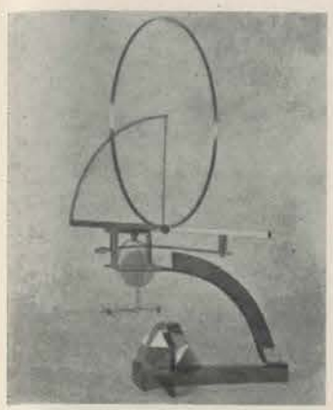
Whether naturalistic or stylized, whether sculpture in round or relief, whether executed 500 years ago or today, the same stages may be noted in the treatment of the material and the grasp of volume.

22a. The New Bauhaus, first semester, 1937 (from left to right). Sculptures by K. O'Brien, W. Greene, T. Van Vossen, B. Rubin, P. Pavlicek.

In the modeling class the students work with the relationships of volumes, positive and negative, full and hollow, values of shapes and proportions and surface treatment of different kinds.

23. L. Moholy-Nagy, 1921. Nickel sculpture.

The completely perforated, completely broken-through, piece of sculpture demands on the one hand a developed technical knowledge, and on the other hand a mind that works abstractly: a freeing of material from its weight, a passing beyond expressional ends.



24. N. Gabo, 1926. Construction.

Engineering assemblage as an economical working principle has had a fundamental influence on the new sculptural creation.

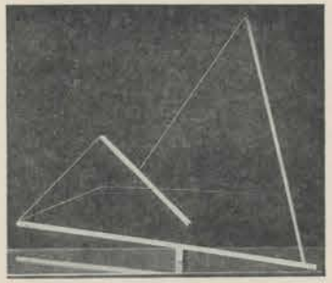
For that matter, the principle of assembling materials is effective in every field of creation. We find it in the technique, also in painting as collage, in photography as photomontage, in the film, as editing and cutting, in the film music where fragments of various moods are combined, and in the literature as the stream of consciousness or automatic writing.

Already Roman sculpture showed the conscious use of metals, in combination with marble of different colors. But these statues (in the Louvre) look to us today much like applied art. Archipenko was the first who made the attempt with assembled sculptures. It was a challenge to the applied art evaluation of materials. He did not want to give the illusion with his materials of the upper surfaces (silk, skin, etc.). His wood was to stand for wood, his metal for metal, etc., and have its own value.

The introduction of the high polished surface, machine-like assemblage of the new constructivist sculptures became the harbinger of "industrial art."

25. Jacques Lipchitz, 1928. Sculpture (bronze).

One could make an analysis of treatment of material, proportions, psychic and compositional factors, etc., for most examples of sculpture. We restrict ourselves to note the stage of volume grasp.



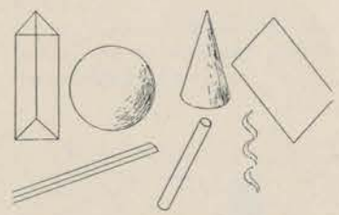
26. Johannes Zabel (Bauhaus, first semester, 1923). Construction in equilibrium (balanced on a small surface).

Succession in time. In the history of sculpture these stages of plastic development occur successively. Each closed culture (Egypt, Greece, Mexico, India) shows, at the beginning, the barely modeled block, and, as a next step, the more or less carefully modeled piece, penetrated to a greater or less extent. Complete perforation appears to have been the last discovery. This is found outside Europe, among some of the so-called "primitive peoples" (Indian, Negro and South Sea), where sculptural creation rests on very old traditions, and where the usual materials — wood or clay — are not hard to work.

Geometrical and biotechnical elements. Until a short time ago, geometrical elements, such as the sphere, cone, cylinder, cube, prism, and pyramid, were taken as the foundation of sculpture. But biotechnical elements now have been added as a new group available for application. In spite of this, the *form concept* of sculpture, the *plastic form*, is understood in this book as the stages of plastic development — and not as the application of geometric or biotechnical elements (solids).

The sculptor of today knows usually little of engineering problems. Division of surfaces, the golden section and the like, are, to be sure, taught in the academies, but nothing about statics, mathematics, technology, although an understanding of these would be more helpful than esthetic rules in suggesting an efficient working method. The constructivists attempted to break the fetters. In their need of getting away from a false ethos, from an excessive respect for fossilized works, their slogan became: "Art is dead, long live life!"

The artist of yesterday concerned himself but little as to exact calculations of balance in his work. Considerations of a few pounds, or even of a hundredweight more or less, did not enter into the older sculpture at all. In the Institute of Design the students are taught to have strict regard for these components and ounces saved — the effect remaining the same — often represent a little victory of ingenuity.



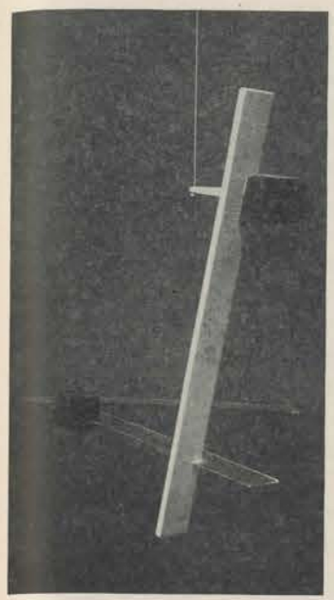
27. The seven biotechnical elements: crystal, sphere, cone, plate, strip, rod, and spiral (screw).

Biotechnical elements formerly entered more particularly into technology, where the functional conception called for the greatest economy. Raoul Francé has distinguished seven biotechnical constructional elements: crystal, sphere, cone, plate, strip, rod, and spiral (screw); he says that these are the basic technical elements of the whole world (Fig. 27). They suffice for all its processes, and are sufficient to bring them to their optimum. The constructive application of these elements, in particular the spiral (screw), has led to solutions that are astonishing in their relation to earlier (baroque) aesthetic principles.

Today we consciously employ the whole stock of biotechnical elements, and the outcome is a new conception of beauty — exemplified by radio towers, spiral stairways, chemical plants, etc.

The fourth stage of sculptural development. What comes beyond the complete perforation of the third stage is a speculation that we, still deeply rooted in our yesterdays, can scarcely grasp; a bold sublimation of the material, a triumph of relations. It is the *equipoised sculpture*, a self-contained volume. Its preparation can be traced in the successive steps of sculptural development.

Whereas static works of sculpture, resting on a base, occupy a certain position in relation to their surroundings, and also have relations of direction to the ground — horizontal, vertical, oblique — equipoised sculptures contain, theoretically, relations of material and volume only within their own system.



28. Irmgard Sörensen-Popitz (Bauhaus, first semester, 1924). Equipoised sculpture (illusionistic).

Freedom from relations to points external to the sculpture constitutes the fourth stage of sculptural development. This stage has as yet scarcely been realized.

The first attempts at creating equipoise made use of an illusionistic solution. The sculpture, instead of being placed on a base — leaving it still a sort of high relief — was erected on a few points of support. (But if these points of support had been connected, the old broad base would have re-appeared.) At a later stage of development the illusion was heightened by the use of glass, or of almost invisible wires, by which the sculpture was hung (Fig. 28).

Examples of equipoised sculpture which do not depend on such an illusion are, for the present, difficult to find. Such sculpture must effectively be kinetic as well, since only through the action of opposed forces can it be brought to balanced rest, to equipoise. Analogous solutions can be seen in balloons, airplanes and toys. All these are limited in their formal quality by unavoidable considerations of the mechanism, of the machinery which must overcome gravity. An actual realization of equipoised sculpture can be made through the application of magnetic forces, or with electric remote control.

Such a possibility can be demonstrated by an electromagnetically controlled metal bar floating between two glass plates.

Within the system of equipoised sculpture we find again the three earlier stages of sculptural form: 1. the block; 2. the modeled; 3. the perforated.

The material values, flexibility, limits of elongation, elasticity, etc., were reckoned in: for example, the strip of glass at the bottom carries a maximum weight.

29. R. Koppe (first semester, 1937). Virtual volume produced through the rotation of a wire construction.

30. Virtual volume. A lighted merry-go-round revolving (Blackpool, England). Virtual, but visible volume (motion).

The fifth stage. In the lightening of masses, the next stop beyond the equipoise is kinetic equipoise, in which the volume relationships are virtual ones, i.e., resulting mainly from the actual movement of the contours, rings, rods, and other objects. Here the material is employed as a vehicle of motion. To the three dimensions of volume, a fourth — movement — (in other words, *time* is added) (Fig. 29).

The heavy block of material, the impenetrable volume, becomes transformed into a spheric extension, seemingly without mass and heaviness; it becomes a weightless poising of volume relationships and interpenetrations. With this transformation, the original phenomenon of: sculpture = material + mass relations, changes to the dematerialized and highly intellectualized formula: sculpture = volume relationships.

Duality of volume? This progress obliges us to use the term "volume" in several connotations (though basically they are formulations of the same meaning).

We mean by volume:

1. The clearly circumscribed mass, a body of measurable weight, tangible in the three dimensions, height, width and depth.
2. Negative volume produced by holes and openings, perceived visually, which, although bodiless, is an outstanding plastic element.
3. The motion of points (smallest bodies), linear elements, planes or bodies which produces virtual volume as a new element of plastic creation.

To sum up what has already been stated, sculpture is the path both from material-volume to virtual volume, and from tactile-grasp to visual-grasp.

Sculpture is the path to the freeing of a material from its weight: from mass to motion (Fig. 30).

Parallel phenomena. We can find very close parallels to this tendency of plastic development, that is, to the lightening up or dissolution of material.

If we turn, for example, to the transformations of water, we come upon a surprising phenomenon — surprising not in its strangeness, but in its commonplaceness. We know water in rest, in motion, in gaseous form, in liquid and solid form. We know it as tiny drops, as the smooth reflecting surface of a pond, stretching far and wide. We know it as a placid or rushing brook, as a raging sea, as pattering rainfall, as a spraying fountain, as a drifting cloud of steam. We know it frozen: as snow crystal, frosted window panes, icicles, etc. Its changes arise from an extraordinary adaptability to the forces acting upon it.

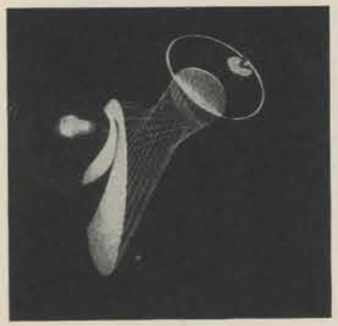
One may easily feel moved to employ water as a medium of expression. In earlier history, water, so responsive to adaptations, was recognized as an important medium of creation, and its natural possibilities were exploited according to the expression wanted. Its form was changed from a tranquil mass to complete dissolution into an almost ethereal form; from the calm lakes of baroque parks to gushing fountains, or to a chain of foaming cascades.

All such efforts were directed toward displaying water under as many aspects as possible; and dematerialization played an important part in the process.

The relations. In every cultural period a phalanx of active forces presses forward in every field of creation, in art, science and technology. It often happens that quick action in one or another pushes a member of this united front forward, like an advancing wedge. This condition does not last long; the others surge onward too, and the phalanx is re-united.

31. Georges Vantongerloo, 1917.
Construction within a sphere as if the outer shell has been removed.

A new experiment: the possibilities of movement within a sphere are immobilized in the material, and shown projected in static form.



Thus a similar quest for expression by subduing or lightening the material is to be found . . .

in sculpture: from mass to motion (Figs. 29-32);

in painting: from colored pigment to light (display of colored light);

in music: from instrumental tones to electronic purity (ether wave music);

in poetry: from syntax and grammar to relations of single words;

in architecture: from restricted closed spaces to free fluctuation of forces.

32. Joost Schmidt, 1928.
Hyperboloid sculpture.

The necessity of studying virtual volume comes today through the automata, machines, and appliances moved by electricity or other forms of power.

Much could be contributed to sculptural experience with artificial adjustable lighting, planned in advance, as opposed to previous works of sculpture so to speak, "daylight sculpture" seen with the light entering from above. But if a painter-sculptor attempts something in the way of "light sculpture" his enthusiasm soon encounters practical obstacles, since private means are not sufficient for comprehensive experimentation.

Fireworks are play and science at the same time. They also give evidence that a precalculation of direction, movement, color, etc., may produce a sensible augmentation of the effects. However, we are today still afraid of "deliberateness" in a "work of art" — and to be sure the intellectual scope and effect of "art," in the judgment of the "expert," would have to be on an incomparably higher plane than mere "play"!

The photograph of a firework, usually a time exposure, registers the sequence of the exploding firecrackers on the same picture plane thus showing spatial "simultaneity" of their paths: an interpenetration of time and space.

The history of kinetic sculpture. The history of kinetic sculpture begins far back in ancient history, with the very first Greek clockwork automata. As a step toward kinetic sculpture in our own time, one may mention certain toys, advertising signs, fountains, fireworks, and the like. These often contain interesting suggestions for experiments. The futurists came forward as conscious propagandists of the dynamic as a principle of artistic creation. Boccioni presented the first "dynamic" pieces of sculpture in his book "Pittura, scultura futurista (dinamismo plastico)." In 1912 he wrote:

"The futurists broke down the concept of repose — the static — and put forward that of motion — the dynamic. They showed a new grasp of space by bringing into contrast the inner and the outer."

Written as a challenge to the aims of the Russian constructivists, the "Realist Manifesto" of Gabo and Pevsner, of Moscow, was published in 1920 ("i 10," No. 7, Amsterdam, 1927).* Here are excerpts from it:

"Space and time are the two exclusive forms for fulfillment of life, and therefore art must be guided by these two basic forms, if it is to encompass true life.

"To incorporate our experience of the world in the forms of space and time: this is the single goal of our creative art.

"We deny volume as a spatial form of expression: space can as little be measured by a volume as liquid with a measuring stick. For what could space be, beyond an impenetrable depth? Depth is the only form of expression of space.

"In sculpture we eliminate (physical) mass as a plastic element. Every engineer knows that the static power and the power of resistance of an object do not depend on mass. One example will suffice: railway tracks. Notwithstanding this fact, sculptors labor under the prejudice that mass and contour are indivisible.

"We free ourselves from the thousand-year-old error of art, originating in Egypt, that only static rhythms can be its elements. We proclaim that for present-day perceptions, the most important elements of art are kinetic rhythms."

In 1922 I published, in collaboration with Alfred Kemeny, a manifesto on "The dynamic-constructive system of forces" ("Sturm" No. 12/1922, Berlin). I quote some sentences:

"Constructivism means the activation of space by means of a dynamic-constructive system of forces, that is, the constructing within one another of forces actually at tension in physical space, and their construction within space, also active as force (tension).

"We must therefore put in the place of the static principle of classical art the dynamic principle of universal life. Stated practically: instead of static material construction (material and form relations), dynamic construction (vital constructivism and force relations) must be evolved, in which the material is employed as the carrier of forces.

"Carrying further the unit of construction, a dynamic constructive system of force is attained, whereby man, heretofore merely receptive in his observation of works of art,

(See page 74, the "Light-prop," 1922-30.)

* This has been translated in full in "Art of This Century," edited by Peggy Guggenheim, N. Y. 1942.

experiences a heightening of his own faculties, and becomes himself an active partner with the forces unfolding themselves.

"The first projects looking toward the dynamic-constructive system of forces can be only experimental, demonstration devices for the testing of the relations between man, material, power and space. Next comes the utilization of the experimental results for the creation of freely moving (free from mechanical and technical movement) works of art."

Light. In this connection, light — as time-spatial energy and its projection — is an outstanding aid in propelling kinetic sculpture, and in attaining virtual volume.

Ever since the introduction of the means of producing high-powered, intense artificial light, it has been one of the elemental factors in art creation, though it has not yet been elevated to its legitimate place. The night life of a big city can no longer be imagined without the varied play of electric advertisements, or night air traffic without lighted beacons along the way. The reflectors and neon tubes of advertising signs, the blinking letters of store fronts, the rotating colored electric bulbs, the broad strip of the electric news bulletin are elements of a new field of expression, which will probably not have to wait much longer for its creative artists (Fig. 33).

33. N. Lerner (New Bauhaus, first semester, 1937). Light volume study.

Lerner comments on his study as follows: "Usually light was not considered as plastic means, only as an auxiliary medium to indicate material existence. Now a new period starts where light will be used as a genuine means of expression because of its own qualities, own characteristics. This photographic experiment reveals the fluid plasticity of light, its ability to radiate, pass, infiltrate, encircle. Also it reveals that through these actions light is able to create negative patterns, lightless volumes which may be, in time to come, as important as its universally appreciated opposite: light reflection."

The creative manipulation of light can be discussed under two main headings:

1. Light displays in the open air:

a) *the illuminated advertising displays* of today still generally consist of linear patterns on flat surfaces. It is our task to enter the *third* dimension by the use of special materials and reflectors;

b) *gigantic searchlights and sky-writers* already play an increasingly important role in advertising displays and

c) *projections on to clouds* or other gaseous backgrounds through which one can walk, drive, fly, etc.;

d) *light displays* will form an impressive part of future municipal celebrations, revealing to the spectator, seated in an airplane, a vast expanse of light with ever changing planes and angles, an interminable network of multi-colored beams.

2. Indoor light displays:

a) the *film* with its unexplored possibilities of projection, with color, plasticity and simultaneous displays, either by means of an increased number of projectors concentrated on a single screen, or in the form of simultaneous image sequences covering all the walls of a room;

b) *reflected light displays* of pattern sequences produced by color organs; such displays may be open for many or limited to a few; they may be individual improvisations, isolated nature or they may be multiplied by means of television;

c) the *color piano*, whose keyboard is connected with a series of graduated lamp units, illuminates objects of special materials and combines the plan of pattern with color;

d) the *light fresco* that will animate vast architectural units, such as buildings, parts of buildings or single walls, by means of artificial light focused and manipulated according to a definite plan. In all probability a special place will be reserved in the dwellings of the future for the receiving set of these light frescoes, just as it is today for the radio.

Ability to recognize a certain stage of sculptural development does not necessarily mean an aesthetic experience. The foregoing is far from an exhaustive treatment of the problem of sculptural creation. Only the first steps have been explained. The five stages of plastic development offer merely rough differentiations of the outward, technical conception, through which one may recognize the greater spiritual problems involved in perceiving sculptural form. The complete experience of sculpture implies — along with intuitive grasp — knowledge of the workings of other elements as well.

Such elements — which again are only first steps — are the geometrical and biotechnical elements of construction, laws of light, motion, size, mass (proportion), relations of structure, texture, surface treatment, representation, expression, etc.

As is the case everywhere, it is true here that a wide and comprehensive knowledge of characteristics and elements is less important for creative work than the capacity and the courage to build up *new relations* among the elements of expression already at hand, to raise them above the commonplace by giving them a new interpretation — sometimes through shifting their meaning. This state of mind is most successfully attained if one relies on the center of certainty in the active human being, whose existence and responsibility are grounded in the actual — in the social sphere.

Without this sureness, elements harmonious in themselves can never grow into an organism. They remain only a series, forming perhaps a rich arabesque, but of no significance in the sense of building up the biological "nourishment" of man.

A bypath. Before discussing an encyclopaedia of the elements of sculptural creation, we must speak of the purpose of the representation, and the related questions of psychic expression and its intensity of effect. These factors are still considered the most essential in sculpture, although they do not fundamentally belong to the elements from which the plastic creation is built up in its purest form.

Representation. To primitive man representation of an object probably meant the same thing as being able to seize the original, to own it personally. It brought the real object which moved or overpowered him before his eyes in graspable dimensions.

At times he tried, in this way, to put the object depicted to his service. The incomprehensible fact of death he made tangible by the death mask, which was likewise the origin of the portrait. By mummification man was changed into a doll; the dead ancestor, the root of the family, remained as a mummy in the family possession. A later stage sublimated this process. The possessive point of view was extended to beings who lived only in the world of imagination. There was a presentment of ancestors not personally known, of gods, personified powers of a rich pantheism. Captured within a definite shape, they thus became — even if prayed to as deities — servants of man.

Clay, wood, stone came to life under the artist's hands. After that, the attempt was made to repeat things that moved him, in their outwardly projectable, experienced, or representational shapes. He perceived, too, the existence of the typical, and what was common to different phenomena was re-created in similarities of representation. Then, one day, slight deviations from the typical were observed. To the original observation of the typical features were added individual characteristics.

The slightest twitchings of the muscles of the face and body were given their values in expression. The whole representation was brought down to infinitely fine gradations. The way led from the typical to the individual. And when no further progress in this direction was possible, when the representation had again reached mask-like mechanical perfection, a rebound occurred. Instead of quivering, tangible naturalism, there was a neutralizing calm, stylization, rigidity, and suppression of the individual, a striving for indifference toward the psychological. In the next stage this led to a stressing of the psychophysical (sensory-reactive) effects of factors of volume, shape, relation, and material. This was a great discovery: a genuine language available for expression. In the transitional period objects were represented in which no value was placed in regard to psychic factors, such as an absinthe glass, a violin. Later, in constructivism, even the neutral object disappeared. The aim was no longer the reproduction of objects in the search for a resemblance to life, not the representation of the object, or even of sentiment, but the establishing of relations of volume, material, mass, shape, direction, position and light, symbolizing the meaning of a new reality, based upon all-embracing relationships.

As to precepts of harmony. From the very beginning of cultural history there were efforts to work out formulas which could resolve the intuitive factors of human experience into predictable and manageable plastic expression. There have been repeated efforts to lay down canons which, if followed, are supposed to assure proficiency in a chosen field of creation.

Today we are skeptical about the rules of harmony. We do not believe in mechanical recipes for art. We know that harmony does not abide in an aesthetic formula but in the organic and uninterrupted functioning of each element within the entity. From this point of view, the knowledge of canons of any kind is much less important than the presence of the right human equilibrium. *To approach a work from a balanced attitude is almost the same as to solve it in a harmonious form.* It is to give it true "meaning." In this attitude, and not in the canons of harmony, lies the "mysterious" power which can give to a sincere expression — embodied in a specific material — its harmony, as well as its justification. Of course, "human equilibrium" is not an absolute measurement, but is dependent on biological, psychological and social components.*

Precepts of function? The biological make-up of man is the source of organic expression. From this point of view one might attempt to incorporate its drives in precepts in regard to function.** It would then be possible to set forth "directions for use" for organic — not "harmonious" — application of the elements.

Indeed, this has been attempted. The old teachings about proportion were partly based on biological assumptions, translated into geometry, which was the visual mathe-

* Six of the Bauhaus books (Verlag Albert Langen, Munich) discuss this question:
Theo van Doesburg, *Grundbegriffe der neuen gestaltenden Kunst.*
W. Kandinsky, *Punkt und Linie zu Fläche.*
Paul Klee, *Pädagogisches Skizzenbuch,* (transl. as *Pedagogical Sketchbook,* New York, 1943)
Kasimir Malevich, *Die gegenstandslose Welt,* (to be translated in D.M.A.)
Piet Mondrian, *Neue Gestaltung,* (cf. *Plastic Art and Pure Plastic Art,* D.M.A., New York, 1945)
L. Moholy-Nagy, *Von Material zu Architektur,* (transl. as *The New Vision,* 3rd edition, D.M.A., 1946)

** In the magazine *i 10* (published in Holland) Heinrich Jacoby announced an article on "The common biological basis of all creative work." The article was never published, unfortunately, but the title has been vindicated beyond doubt by Jacoby's previous works.

matics of ancient times. They measured human proportions according to "the golden section." All these measurements were based upon a primitive geometry, the hexagram, and other laws of harmony. Their importance has not diminished, especially in regard to painting, since cubism and constructivism do not hide at all their basic geometric construction. However, to supplement these constructions, there is need of a thorough co-ordination of the laws to which man is subject, and upon which his biological existence depends. Higher mathematics, physics, and other sciences can perhaps take the lead, so that a clear presentation of these laws can be offered as a foundation for functional expression. They might give us the key to all the phenomena which we perceive as harmonious.

But who is capable of codifying the laws of human functions for that purpose?

A method of observation directed more toward fundamentals would inevitably lead to the recognition that the biological functions of man are not only of amazing multitude, but also of extraordinary subtlety, and that, in their borderlands, countless possibilities lie dormant, awaiting stimuli to call them forth.

For every human motion, for example, there is a corresponding bodily position, and in these various positions, the body is always in an equilibrium which is attained by reflex actions. Thus the human organism, even in unforeseen, complicated situations exhibits, mentally and physically, inwardly and outwardly, an unparalleled "quick-wittedness." The constant readiness of each organ to function, to play its part, as the occasion demands, within the structure as a whole, makes possible the body's capacities for an organically conditioned functional behavior. This, and nothing else, is the basis of its "harmony," as well as the "proof" of its "right" design.

One has only to observe how a man, suddenly attacked, instinctively assumes a position of defense; how a man catches his balance when he stumbles or slips. Often the movements are too rapid for observation, and here the slow-motion picture comes to the assistance of the eye. The fall of a skier, for example, photographed with the slow-motion camera, loses any element of the grotesque, and becomes a balanced, harmonious action. It seems that the next step in analyzing harmony must be more connected with the laws of kinetics than with the laws of statics.

Precepts of elements? We can approach the problem from another side. Every expression may be resolved into a series of elements. Every element is registered physiologically, and every physiological experience has also its psychological equivalent. The sensory-reactive (psychophysical) effect of sensorily perceptible elements (color, tone, etc.) forms the basis of our relations to objects and expression. It forms also the material basis of art.

For the sensory-reactive (psychophysical) effect of elements, we as yet possess no uniform data, aside from some expressions of popular speech. For example: green is the color of envy, and blue of depression. Bulls are said to be infuriated by red. The music of the glass organ brings tears to the eyes.

Primitive peoples still have knowledge of the psychophysical effects of food and drink. It is thought, for instance, that the management of the kitchen insures for women in primitive societies — more than elsewhere — mastery over men.

In a single field, that of color, preliminary steps toward clarification have been taken. Goethe attempted to determine the sensory-reactive effect of the various colors, and of combinations of colors, but his terms were not sufficiently differentiated to be applied to paintings, with their complex color combinations.

In a teaching of the psychophysical effects of color, countless fine gradations should be elaborated, and even these would change their meaning if their shape or position were changed. The number of cases presented by practice is so great that every example must be expressed in the subtlest nuances of language, if it is not to lead to false results, in regard to other combinations. Furthermore, in the course of time the very elements may change their meaning. An effect is often dulled by repetition; what elicited a keen reaction in one period, may in the next be worn out. And even our predisposition toward certain reactions to given phenomena may itself alter. Thus we can understand that the effect of the richer combinations of colors, as contained in a picture, for example, cannot really be grasped by logical and habitual associations processed verbally. We perceive such effects for the most part independently of intellectual processes, more or less unconsciously. If this interpretation is accepted, it must be evident that exact formulations are possible only where the psychophysical effect of the *single* element in a certain shape and position is under consideration — and not even there with certainty. As soon as these single elements are combined with one another, the possibility of exact description of their effect ceases. The elements may be employed according to a known arrangement, and still there will result, independent of any conscious control, another structure.

In spite of this, and without trying to say that the totality of an expression comes from mere addition of its parts, a familiarity with the basic elements of expression may be of valuable assistance. These elements may be welded into a synthesis if an organic desire for expression gives an impetus for it. This does not, to be sure, establish a system of harmony — but it teaches at least the elementary principles of producing quality. The scope of such a study is to survey and organize all the utilizable elements of expression. This study of the basic elements may then play the role of a well-stocked *chest of tools*, or of a dictionary, but it cannot give security to the creative work itself.

At times it is sufficient to show a man the rich choice of elements at his disposal, and his inner assurance will lead him to select in accordance with his own desire for expression. The building of organic relations to effective unity must then be left to his own powers; the way of using the elements can be directed only by socio-biological necessities.

An attempt. We may outline a framework of a systematization of the elements of artistic creation. The outline itself is an abstract, which may be worked out concretely in any given material.

Such a survey offers at first only a deepening of knowledge, an assistance in enhancement of the cultivation of vision and other senses. But it may become also a stimulus to creative work, which must, however, acquire its meaning, as has been so often stated in this book — from within, from the biological.

Outline of a general system of elements.

A general systematization of elements is based upon the relations of

I. forms already known, such as
- mathematical and geometrical forms;
- biotechnical forms;

II. newly produced forms, such as
- free forms.

The production of *new* forms may be founded on:

1. relations of measurements (the golden section, and other proportions)
- position (measurable in angles)
- movement (speed, direction, push, intersection, telescoping, interlocking, penetration, interpenetration)

2. the different aspects of materials
- structure
- texture
- surface treatment
- massing

3. light (color; visual illusion; reflection; mirroring).

The relationship of forms may become effective as:

1. contrasts
2. deviations
3. variations

a) shifting, dislocation
b) repetition in series
c) turning
d) mirroring

} and their combinations

The difficulty of application. The difficulty of applying these elements lies — as already mentioned — in our newly changed conception: from static to kinetic. Harmony, in classical terminology, means tranquility, the crystallized position of the elements. The new kinetic form of creative work implies a steady flux, sometimes a rapid change, a constant shifting of the position of the elements. Geometric rigidity comes to an end.

It is significant that even the static constructions of our day are already influenced by these tendencies, derived from the new kinetic reality which began with the motion picture. They have overthrown the validity of some age-old observations, e.g., the decisive importance of size and weight, which become negligible by the introduction of motion.

IV. Space (architecture)

Definition of space. Every cultural period has its own conception of space, but it takes time for people consciously to realize it. This is the case with our own spatial conception. Even in defining it, considerable hesitation prevails. This uncertainty is evident in the words we employ; and the words increase the confusion.

What we know of "space" in general is of little help in assisting us to grasp it as an actual entity.

The different kinds of space.* We speak today of:

mathematical	isotropic	
physical	topographic	
geometric	projective	
Euclidian	metric	
non-euclidian	homogeneous	
architectural	absolute	
dance	relative	
pictorial	fictive	
scenic	abstract	
spherical	actual	
crystalline	imaginary	} space
cubic	finite	
hyperbolic	infinite	
parabolic	limitless	
elliptical	universal	
bodily	etheric	
surface	inner	
lineal	outer	
one-dimensional	movement	
two-dimensional	hollow	
three-dimensional	vacuum	
n-dimensional	formal, etc., etc.	

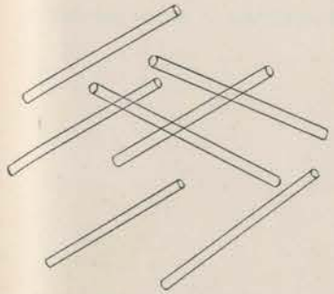
* See also: Dr. Rudolf Carnap, "Der Raum," Kantstudien, Berlin, 1922 and "Der logische Aufbau der Welt," Weltkreisverlag, Berlin-Schlachtensee, 1928.

Space is a reality. Despite this bewildering array, we know that space is a reality of sensory experience. It is a human experience like others; it is a means of expression like others. Other realities, other materials.

Space is a reality, and once it has been comprehended in its essence, it can be grasped according to its own laws, and arranged according to them. As a matter of fact, man has constantly tried to use this reality *(i.e., this material)* in the service of his urge for expression, no less than the other realities which he has encountered.

Space experience is not a privilege of gifted architects, but is a biological function of everyone. The biological base of space experience is everyone's endowment, just as is the experience of color or of tone. By practice and suitable exercises this capacity can be developed. To be sure, there will be many degrees of difference, from minimum to maximum capacity, but basically space experience is accessible to everyone, even in its rich, complicated forms.

Its grasp is of the greatest help in conceiving any design.



34. Space relationship created through the position of rods.

This type of relationship gives the eternal pattern for the use of columns as architectural means.

One usually understands spatial relationship in reference to architecture but in reality many spatial relationships exist besides those of architecture. To demonstrate a simple but rich spatial effect, one should slide his hands up and down and right and left. The relationship of the fingers each to the other creates changing position of bodies (rods) which gives a spatial sensation. This is a basic exercise of a spatial a b c. In experimental examples of spatial exercises the role of the moving fingers can be exchanged into movable linear elements which produce spatial effects.

Space is the position relation of bodies. A definition of space which may at least be taken as a point of departure is found in physics — "space is the relation between the position of bodies."

Therefore: spatial creation is the creation of relationships of position of bodies (volumes). On the basis of volume analysis, we can understand bodies, whether large or minute, in their smallest extensions, e.g., thin plates, sticks, rods, wiring, and even as relations among limits, terminations, and openings (Fig. 34). The definition of course must be tested by the means by which space is grasped, that is, by sensory experience.

The means. Each of the senses with which we record the position of bodies helps us to grasp space. Space is known first of all by the sense of vision. This experience of the visible relations of bodies may be checked by movement — by the alteration of one's position — and by means of touch (Fig. 34).

From the point of view of the subject, space can be experienced most directly by movement, on a higher level, in the dance. The dance is an elemental means for realization of space-creative impulses. It can articulate space, order it.

Vaudeville, circus, stage, cinema, and light display can be of the same order of space creation.

Further possibilities for experiencing space lie in the organs of hearing and of balance,* and in other possible space-experiencing sensory centers of our body, as

* In the "Buch der 1000 Wunder" by Fürst and Moszkowski (Albert Langen Verlag, Munich) there is a description of some experiments of interest in this connection. "Das wirbelnde Meerschweinchen" (swirling porpoise), p. 106, treats of the localization of the sense of balance; "Ein Schritt vom Wege" (a step from the path), p. 60, space orientation; "Biene und Geometrie" (the bee and geometry), p. 83, also deals with the latter. "Das Formhören" (hearing of form), p. 57, gives a report on possibilities of distinguishing forms and space through hearing, as does also the chapter "Augenersatz für Blinde" (substitutes for eyes for the blind).

35. O. Firle, 1928. Elevator shaft.

yet imperfectly localized, so far as we know. The study of newer fields of consciousness, such as telepathy, may render a service in this connection.

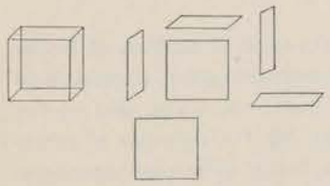
Man perceives space:

1. through the sense of sight in such things as sticks, rods, wiring; columns, bodies; surfaces meeting and cutting one another; interpenetrating objects; wide perspectives; relationships of mass, light, shadow; transparency; reflection; mirroring (Figs. 36, 37, 40, 44).

2. through the sense of hearing by acoustical phenomena; reflected sound; echo.

3. through the sense of equilibrium by circles, curves, windings (spiral stairways) (Figs. 35, 39).

4. through the means of movement by different directions in space (horizontal, vertical, diagonal); intersections; jumps, etc.



36. Volume and space relationships. If the side walls of a volume are scattered in different directions, spatial relationships originate.

The conception of the "façade" is already eliminated from architecture. There is no place left in the building which has not been adapted to some functional use. The exploitation of the front (balconies, electrical advertising signs) is continued by that of the roof (roof gardens, airplane landing stations).

37. Le Corbusier, 1925. Dwelling house.

A "section of space" is cut out of "cosmic" space by a network of strips, wires and glass, just as if space were a divisible, compact object. The new architecture is in complete interpenetration with outer space.

The ocean liners built since the nineties are the precursors of modern architecture. The necessity of attaining maximum space content and complete stability with the smallest possible weight forced the shipbuilding engineer to solutions similar to those the modern architect achieves.

The experience of architecture. The road toward experiencing architecture thus proceeds through a functional capacity for grasping space. This is biologically determined. As in every other field, one has to accumulate much experience before a real appreciation of the essential content, articulated space, can be enjoyed. Unfortunately this approach to architecture is rare. Most people still look for stylistic characteristics, such as: Doric pillars, Corinthian capitals, Romanesque arches, Gothic rose-windows, etc. These are, of course, certain types of spatial construction, but they do not present evidence about the *quality* of space creation itself.

It is this traditional education which is responsible for the fact that the "educated" man cannot really evaluate architectural work as an expression of space articulation. The actual felt quality of spatial creation, the equilibrium of taut forces held in balance, the fluctuating interpenetration of space energies, escapes his perception. A symptom of our time is that this lack of discrimination is also common in architects, who look for the essence of architecture in the meaning of the conception of *shelter*. It happens that many "modernistic" architects take from revolutionary architecture only stylistic characteristics, as, for instance, a misunderstood "cubist" exterior. Their point of departure is the arrangement of a series of rooms, a kind of practical solution, but never really architecture in the sense of articulated space relations, to be experienced as such. Every architecture — and all its functional parts, as well as its spatial articulation — must be conceived as a whole. Without this, a building becomes a piecing together of hollow bodies, which may be technically feasible, but which can never bring the exhilarating experience of articulated space.

Practical application. If the elements necessary to a building fulfill their function they become part of a space reality, transcended into a spatial experience. The space reality in such a case is nothing less than the most efficient co-operation between the organization of the plan and the human factor. Our present mode of living plays a significant role, but it does not prescribe the manner of space creation. Only when the facilities for different functions — for traffic, moving about and visual factors, acoustics, light, and equilibrium — are conceived in a constant balance of their spatial relations, can we speak of architecture as a spatial creation.

Basic architectonic questions. In planning a building the most varied problems come up: social, economic, technological, hygienic. It is probable that upon their correct solution the fate of our generation and the next depends.*

But attending to social, economic, and hygienic problems does not absolve the architect from the responsibility of further effort and thought. To be sure, a great step in advance has been taken, if, along with the financial and technical considerations, the problems of structure and social economy, technique and efficiency, are seriously examined. But the real architectonic conception, beyond the fusion of all purposeful functions, is usually not discussed, namely, space creation, perhaps because its content is accessible to few people. Yet in addition to the fulfillment of elementary physical requirements, man must have the opportunity to experience space in architecture. For example, a dwelling should not be a retreat from space, but a life *in* space. A dwelling should be decided upon, not only on the basis of price and the time it takes to

* Adolf Behne selected as the motto of his popular and human book, *Neues Wohnen — Neues Bauen* (Verlag Hesse & Becker, Leipzig), the gruesome saying of Heinrich Zille, "One can kill a human being with a dwelling just as surely as with an axe."

build, not only upon practical considerations of its suitability for use, its material, construction, and economy; the experience of space belongs to the list too, as a psychological need.*

This idea is not to be taken vaguely, or as a mystical approach to the subject. It will not be long before it is generally recognized as a necessary element in the architectonic conception, which will be exactly circumscribed. That is, architecture will be understood, not as a complex of inner spaces, not merely as a shelter from the cold and from danger, nor as a fixed enclosure, as an unalterable arrangement of rooms, but as an organic component in living, as a creation in the mastery of space experience. Individuals who are a part of a rational biological whole should find in their home not only relaxation and recuperation, but also a heightening and harmonious development of their powers.

The new architecture, on its highest plane, will be called upon to remove the conflict between the organic and artificial, between the open and closed, between the country and city. We are accustomed to neglect these questions because the emphasis is still upon the house as a single unit. The future conception of architecture will consider and realize, beyond the single unit, the group, the town, the region, and the country; in short, the whole. The means to this end may be of many kinds; some day we will surely arrive at this elementary insistence on created space. The standard for architects will then no longer be the specific needs of the dwelling of the individual, or of a profession with a certain economic influence, but will revolve around a general plan, that of the mode of biological living which men must have. After this general foundation is established, variations may be introduced, justified by individual needs.

People are today conducting investigations of biological requirements in different fields of experience. Their research seems to produce results which are related.

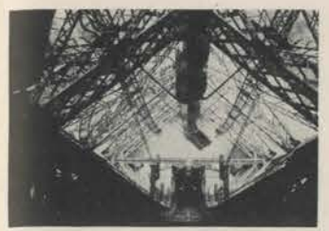
Efforts to realize a new spatial conception and creation — important as they are — should therefore be understood only as a component of this new orientation.

Architecture will be brought to its fullest realization when the deepest knowledge of human life as a total event in the biological whole is available. One of its important components is the ordering of man in space, making space comprehensible by its articulation.

The root of architecture lies in the mastery of the problem of space; its practical development lies in technological advance.

The boundary between architecture and sculpture. Although architecture and sculpture are separate domains, the treatment of space at times easily may be confused with treatment of volume. In other words: to the untrained eye, sculpture may appear as architecture, and a work of architecture as enlarged sculpture (Fig. 38). The latter was almost always the case with classical architecture, where the modulation of masses and bodies (volumes) was predominant. But space creation in our time has changed the meaning of architecture. A brief explanation may clarify this. If the side walls of a volume (i.e., a clearly circumscribed body) are scattered in different direc-

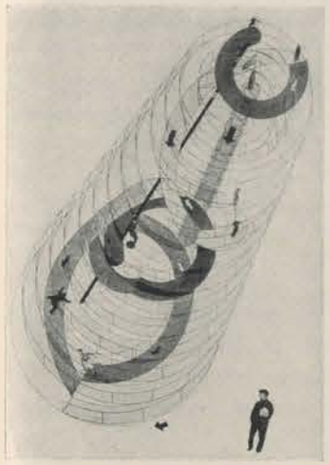
* A valuable theoretical study, perhaps the most valuable of recent years, on the question of architecture, is the book by S. Giedion: "Bauen in Frankreich, Bauen in Eisenbeton, Bauen in Eisen" (Verlag Klinkhardt & Biermann, Leipzig). Giedion attempts to show that in modern construction the correct application of materials and principles of economy is that which produces the actual architectural creation. But he also says that material and construction are only means to the realization of architecturally envisioned ends. His latest book "Space, Time and Architecture" (Harvard University Press, 1941) is once more an important and excellent contribution.



38. The Eiffel Tower.

The Eiffel Tower is on the border line between architecture and sculpture. According to the definition laid down in this book, it is a piece of sculpture: a volume creation. It is a broken-through, completely perforated "block."

tions, spatial patterns or spatial relations originate. This fact is the best guide to judgment of modern and pseudo-modern architecture. The latter shows only volume articulation, in comparison with the rich space articulation — i.e., relations of planes and slabs — of modern architecture (Fig. 36).



39. L. Moholy-Nagy. The construction scheme of the kinetic constructive system, 1922.

The structure contains an outer path mounting spirally, intended for general recreation and therefore equipped with a guard-rail. Instead of steps, it is in the form of a ramp. The path ends at the top in a semi-circular platform which has access to an elevator shaft. The upper end of the platform is jointed, while the lower end emerges on a horizontal which takes the public out by a downward escalator. The horizontal ring-shaped platform glides downward in respect to the elevator and by means of the turning of the whole structure. The path of motion for it is the inner spiral. Parallel to the outer path there is a further spiral, with the steepest practicable incline, for the use of more athletic visitors. This, unlike the outer path, has no rail.

Above the upper platform for the public there is a horizontal plane forming three quarters of a ring, which is the terminus of the "athletes' track," and is connected with a slide pole parallel to the elevator shaft. The slide pole, by means of a flexible attachment, can be moved to any point on the upper ring-shaped surface, and can also be swung to any point of the ground level of the whole structure.

The figures indicate the scale and the arrows the direction of motion.

An analogy. The fact that kinetic sculpture exists leads to the recognition of a space condition which is not the result of the position of static volumes, but consists of visible and invisible forces, e.g., of the phenomena of motion, and the forms that such motion creates (Figs. 17, 29, 30-32, 39 and page 74).

The phrase "material is energy" will have significance for architecture by *emphasizing relation, instead of mass.*

Instead of static: kinetic. What we grasp of kinetics today is slight. The building materials at our disposal permit extraordinary performances, but they scarcely come near the "fantastic" idea of a kinetic space creation.

What we have conquered up to now is in close contact with technological forms appearing in other fields. The common denominator is the concept of the dynamic (kinetic), in contrast to the static, hierarchic fixation of earlier periods.

Formerly the architect constructed his buildings from visible, measurable, and well-proportioned volumes, calling them "space creations." But real spatial experience rests on simultaneous interpenetration of inside and outside, above and beneath, on the communication of the in and the out, on the often invisible play of forces present in the materials and their relationships in space.

Space creation is not primarily a question of the building material. Thus a present-day space creation is not a compound of heavy building masses, nor the formation of hollow bodies, nor the relative positions of well-arranged volumes; nor an arrangement, alongside of one another, of single cells of the same or of a different volume content.

Space creation is an interweaving of the parts of space, which are anchored, for the most part, in clearly traceable relations extending in all directions as a fluctuating play of forces (Figs. 16, 33, 36).

This space is effected on the measurable plane by the limits of bodies, and on the non-measurable plane by the dynamic fields of force. Space creation becomes the nexus of spatial entities, not of building materials.

Building material is an auxiliary; just so far can it be used as medium of space-creating relations. The principal means of creation is the space itself, from whose conditions the treatment must proceed.

40. Frank Lloyd Wright, Robie House, Chicago, 1906. A new spatial approach through use of slabs.

The historical sequence. The historical sequence of the development of spatial treatment can be indicated, just as in sculpture. It will merely be sketched here. The filling in of details, the finding of appropriate examples, must be left to the reader. It will be sufficient to hold firmly in mind the idea that architectural development has proceeded from volumes to open space relations:

41. Walter Gropius, 1926. The Bauhaus at Dessau.

Fenestrations produced the inward and outward reflections of the windows. It is no longer possible to keep apart the inside and outside. The mass of the wall, at which all the "outside" previously stopped, is now dissolved and lets the surroundings flow into the building.

1. One-celled; closed (hollow) bodies.
2. One-celled; one side open.
3. Bare structure appears; stilts, columns.
4. Several cells, extending horizontally, later vertically; enclosed, compact blocks.
5. Interpenetrating cells; arch, vault, cupola; verticality.

Rich exterior additions make these relations tangible; in spite of this the general impression is a modelled body (sculpture).

6. Every side perforated; fluctuating horizontally (Wright) (Fig. 40).
7. The same, opened in the vertical direction; the interpenetration takes place not only sidewise, but also up and down, for example, a ship's bridge; the work of Gropius, Corbusier, Oud, Mies van der Rohe, and the young architects (Figs. 35, 37, 41).
8. The ground plan of the top is different from that of the bottom; space cells are suspended on the ceiling.

Sculpture discarded in favor of a new creative spatial approach.

42. L. Moholy-Nagy, 1928. Stage set ("Tales of Hoffmann," State Opera, Berlin).

Spatial creation on the stage and in motion pictures. With the exception of the dance, sports, and acrobatics, space creation as a form of human expression — like painting, sculpture, music, poetry — does not exist as a conscious departure. But such a conception, derived from an inner urge, is justifiable, and the circus, vaudeville, theater and motion pictures, as well as occasional exposition buildings, afford sufficient opportunity to realize such space creative activities outside of architecture (Fig. 42). A serious consideration of these possibilities seems to be important, since through them new avenues of release emerge. They also render assistance to utilitarian architecture, that is, in the end, to the people, since in daily life everyone is engulfed by the architecture of utility.

Light creates space.

While artificial sources of light are used to an amazing extent in the motion picture studio and on the stage, the present-day architect, painter or sculptor has hardly any notion of how to employ them. At the same time it is also true that the stage, and more especially the motion picture, are still far from rational in their practical use of light. The splendidly equipped motion picture studios should not plan their lighting and their architecture on unintelligent principles of imitation of **nature, but should exploit the special possibilities of light. The introduction of moving light sources would of itself create a revolution here.**

The stage set for "Hoffmann" is an experiment with the problem of creating space from light and shadow. Among other devices, the wings are employed here to create shadows. Everything is transparent, and all the transparent surfaces work together to make an organized and well perceptible space articulation. It seems that from all this study of material, volume and space, the stage will, first among all the fields of expression, gain the most in the very near future. As soon as it leaves the blind alley of the purely literary — the co-ordination of all the elements will take a decisive step forward.

This is the point at which one might insert the question of the effect of spatial values on sensory reactions, or even that of space perception. But an exact statement appears to be as little practicable today as a similar statement was for Goethe and his followers in the field of color. Language is inadequate to formulate the exact meaning and the rich variations of the realm of sensory experiences. Still, a theoretical approach to the problem of an abstract space creation need by no means be branded as sterile.

The biological pure and simple taken as the guide. The most elementary stage of spatial creation is evidently its significance from the biological standpoint.

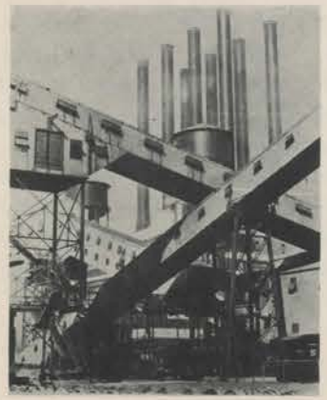
In practical evaluation, space does not have to do with a "sculptural" exterior, but instead with *relations,* which establish the biological conditions necessary for a plan of creative expression in space. Since, in architecture not sculptural patterns, but spatial relations are the building elements, the inside of the building must be interconnected, and then connected with the outside by spatial divisions.

The task is not completed with a single structure. The next stage will be space creation in all directions, space creation in a continuum.

Boundaries become fluid, space is conceived as flowing — a countless succession of relationships.

Aviation has a special part to play in this respect. New views appear below an airplane, and also from looking upward at an airplane. The essential is the bird's-eye view, which is a more complete space experience. It alters the previous conception of architectural relations.

Something similar may be said of the new use of artificial and natural light. For example: A white house with great glass windows surrounded by trees becomes almost



43. Ford factory at Detroit. Photo by Sheeler.

transparent when the sun shines. The white walls act as projection screens on which shadows multiply the trees, and the glass plates become mirrors in which the trees are repeated. A perfect transparency is the result; the house becomes a part of nature.

The use of artificial light may still increase such effects. At night strong light destroys details, devours trimmings, and shows — if used with this end in view — not the façade, but space relations.

Even the more limited spatial creation of industrial buildings and dwellings is making similar advances (Fig. 43).

A path for future architecture is indicated by another point of departure: the inside and outside, the upper and lower fuse into unity (Fig. 44).

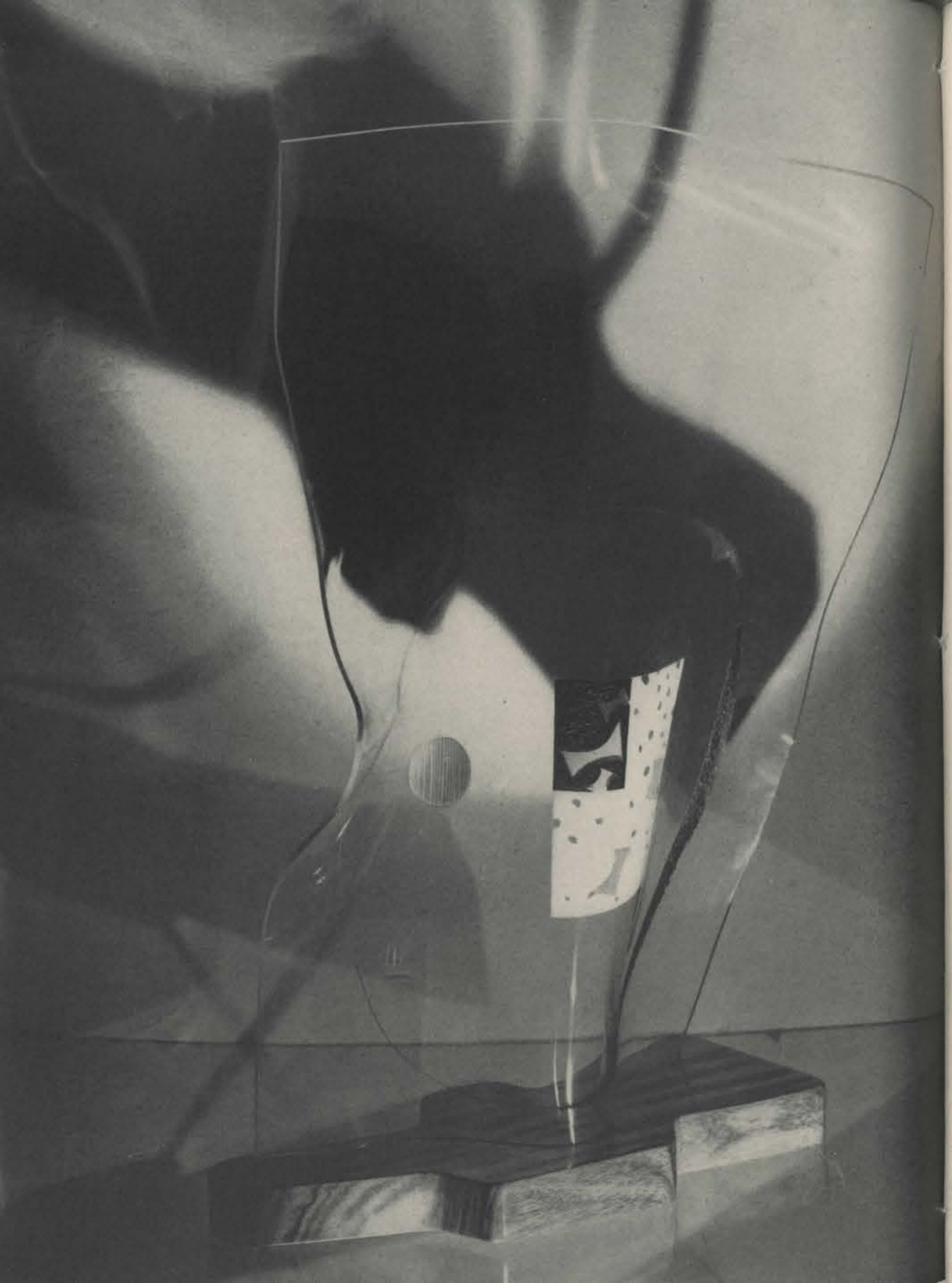
44. "Architecture." Photo by Art Siegel.

The illusion of spatial interpenetration is secured by superimposing two photographic negatives. The next generation will perhaps really see buildings like this, when glass and compressed air architecture develops.

Openings and boundaries, perforations and moving surfaces, carry the periphery to the center, and push the center outward. A constant fluctuation, sideways and upward, radiating, all-sided, announces that man has taken possession, so far as his human capacities and conceptions allow, of imponderable, invisible, and yet omnipresent space.

Abstract of an Artist:*

* All illustrations accompanying this chapter are by the author.



L. Moholy-Nagy. Space modulator with highlights (Plastic shaped by hand, 1942).

The ordinary person is bewildered by contemporary art. The teaching of a distorted history of art, rooted in dogmatic definitions of what ought to constitute art, often prevents him from approaching new modes of expression. Anything which he finds difficult to understand makes him impatient and angry, sometimes even hostile. But there are ways of meeting the situation. The observer's emotional and intellectual interest can be stimulated so that he approaches the subject with a more positive attitude. He can be shown that without special preparation only a minority can follow new trends — mainly because the professional artist, through daily work with his material, acquires a superior understanding of his means, and is led to newer and newer formulations that supersede old standards. These findings are the result of an organic process, a growth in knowledge, experience, and intuition. This can hardly be matched by the layman. But the new formal solutions can act as catalysts for the few who, because of an inclination similar to that of the artist, react positively. Then, slowly and almost unnoticed, as if by a process of osmosis, the work of the new artist diffuses and penetrates through every phase of life. In from thirty to fifty years the process reaches a saturation point. The new form of expression has become part of civilization and the cycle will be renewed.

The process of diffusion may be accelerated. Intellectual preparation and criticism may undo dogmas. Though it is doubtful whether art can ever be fully "explained," it may be helpful to the reader to retrace my own development, and to show how my work in abstract art grew out of a gradual grasp of means and interrelations.

Seeming chaos. I did not begin as an abstract painter. Intimidated by the apparent chaos of contemporary painting, then represented by the fauves, cubists, expressionists, and futurists, I turned to "solid" values, to the renaissance painters. I had no difficulty in "understanding" them. Was I not prepared by novelists and biographers to appreciate their monumentality? Raphael's worldly madonnas, the heavenly smile of the Gioconda and her fine hands, the weighty dignity of Michelangelo — these were already interpreted by writers. We ordinarily like things which we understand, and we usually look for those things which we know by heart. They afford an agreeable reassurance, and confirm our education. It did not occur to me that beyond the illustration of a mythological and religious story, pictures must have other qualities. My eyes were not yet trained to see. My approach was more that of "hearing" the picture's literary significance than of seeing form and visual elements. I was conscious neither of these fundamentals nor of the technique of execution. I would not have

1916.

1917. Self-portrait.

1917. Landscape.

been able to distinguish between originals, copies, or fakes. Then came my discovery of Rembrandt, especially of his drawings. They seemed to be carried only by emotional force, radiating psychological depth and introverted suffering. Impressed by the startling discoveries of psychoanalysis, I found in Rembrandt a foreshadowing of a technique demonstrating this kind of knowledge. In addition, not having much experience in draftsmanship, but haunted by a desire for quick results, my own drawings seemed to have an affinity with Rembrandt's nervous sketches. The next step was Vincent van Gogh. Again, I was more attracted to his drawings than to his paintings. The analytical nature of his ink drawings and their peculiar texture taught me that line drawings ought not to be mixed with half tones; that one should try to express three-dimensional plastic quality by the unadulterated means of line; that the quality of a picture is not so much defined by the illusionistic rendering of nature as by the faithful use of the medium in new visual relations. (Since then I have learned that the artist may mix techniques; in fact, he can do whatever he pleases, providing he masters his means, and has something to express.)

The young painter passes beyond dilettantism, mere subconscious doodling and somnambulistic repetition of examples when he begins to discover problems for himself and then tries to solve them. To consciously work out such "problems" does not constitute a danger, either of losing the potentiality for future development, or emotional freshness. Anyway, the complexity of an expression is usually beyond conscious grasp. The conscious part is a small component, which helps to synthesize the elements, apart from the act of intuitive coordination.* Through my "problem" of expressing everything only with lines I underwent an exciting experience, especially as I overemphasized the lines. In trying to express three-dimensionality, I used auxiliary lines in places where ordinarily no lines are used. The result was a complicated network of a peculiar spatial quality, applicable to new problems. For example, I could express with such a network the spherical roundness of the sky, like the inside of a ball. In the same way, I could render a nude with all the complicated compound curvatures of the body which the traditionally subtly flowing shadows, translated into half-tones, had had to define as organic plastic form. Suddenly I saw that this experiment with lines brought an emotional quality into the drawings which was entirely unintentional and unexpected, and of which I had not been aware before. I tried to analyze bodies, faces, landscapes with my "lines," but the results slipped out of my hand, went beyond the analytical intention. The drawings became a rhythmically articulated network of lines, *showing not so much objects as my excitement about them.*

This again cut a path into the jungle. I learned that the manner in which lines are related, not objects as such, carry the richer message. Van Gogh appeared in a new light. I grasped much better the "meaning" of his curves and shapes. That I had a minor, but entirely personal problem in my work, taught me to recognize and even to look for other painters' problems. Edvard Munch, the Norwegian painter, Lajos Tihanyi, a Hungarian, Oscar Kokoschka, Egon Schiele, Franz Marc — all these appeared decipherable to me — or at least so I thought. I was very much affected by the discovery that, for them, nature was only a point of departure, and that the real impor-

* The intuitive is most accurately understood as a speeded-up, subconscious logic, parallel to conscious thought in all save its greater delicacy and fluidity. Usually the deeper meanings so often ascribed to the intuitive more properly belong to sensory apprehension. Here resides the ineffable. This kind of experience is fundamentally non-verbal but it is not inarticulate to the visual and other senses. Intuitive in the verbal universe is always potentially explicable. Intuitive in the plastic sense, in all the arts, including poetry, is a matter never, probably, capable of conscious verbalization.

1926. Arrangement for a Bauhaus festival.

1936. Window display.

1919.

1920. Still Life.

tance had been shifted to their interpretive power. I now understood why they used unusual combinations of curved, straight and zigzagging lines. This was part of their language, based upon visual fundamentals. This was their way of speaking about their problems, their social consciousness, their individual happinesses and fears. Lines became diagrams of inner forces. With ecstasy I made a drawing; there were no *objects*, only lines, straight and curved. Wheels and bridges scattered on the sheet were the only shapes derived from nature. I called the drawing "Build! Build!" ("Épits" is the Hungarian word for it.) This was in 1917-1919.

From that time on I observed that lines could have a power beyond me, and that, if I wished to control them, I had to be careful not to use them to excess. This helped me to simplify my work. The fewer the lines, the less the opportunity for confusion.

Now, sensing a hidden law in their rich use of lines, I dared to examine cubist pictures. I also tried to become better acquainted with the futurists and expressionists.

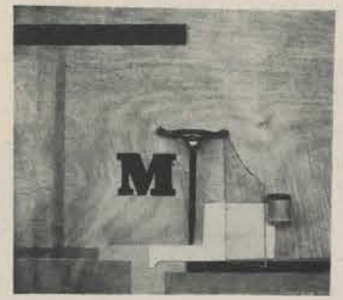
Organization of the picture plane. Today I realize that at the time I was able to see in their work no more than the elements which I had already employed myself. But this was a most productive time of fermentation, a process of maturing. I became more courageous in listening to my own observations. I discovered that "composition" is directed by an unconscious sense of order in regard to the relations of color, shape, position, etc., and often by a geometrical correspondence of elements. For example, some time ago, when painting a still life, I placed the objects on the ground, directly beneath the canvas. I thought I would be able to show them better in this position, to see more from above. At the same time I wanted to frame these objects with the two diagonal legs of the field easel. Thus I painted them to form a kind of a triangle. After finishing the picture, I observed that this triangle not only created a greater depth and dominated the composition, being a frame within a frame, but influenced my color scheme and the position of the colors, too. All the yellows, blues, and reds had been instinctively organized within small triangles. This helped me see the "composition" of old and contemporary pictures with new eyes.

Bored by the old subject-matter, I looked for new subjects and themes. Glass and crystal, salt shaker, T-square, radiator, alcohol burner, semaphore, or iron construction appeared in my paintings — instead of apples, lobsters, and pears.

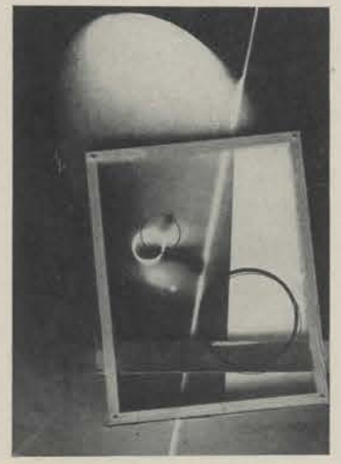
One day I found that my sketch for an oil painting did not carry out my intention. There were too many shapes pressed into a chaotic arrangement. I took scissors. Cutting away some parts of the drawing, and turning it at an angle of ninety degrees, I was satisfied. When the remnants were pasted on a new sheet, the whole had little similarity to the still life which I had chosen as the point of departure. People, accustomed to naturalistic schemes, insisted that this "still life," mutilated and turned upside down, looked like a rider on a motorcycle. I protested, but basically I had a feeling of indescribable happiness, a feeling of the complete autonomy of action. It occurred to me that, if I could make such changes in a drawing, I could also decide with the same freedom the shapes and colors in my oil paintings. Suddenly I understood the *blue* faces and *blue* horses of the expressionists. How wonderfully simple! With this revelation I deliberately changed the color schemes of my "still lifes," and even went one step further. I eliminated the perspective employed in my former paintings. I simplified everything to geometrical shapes, flat unbroken colors, lemon yellow, vermilion, black, white — polar contrasts.

This event marked a turning point in my existence as a painter. That day I sensed

1920.



1920. Collage.

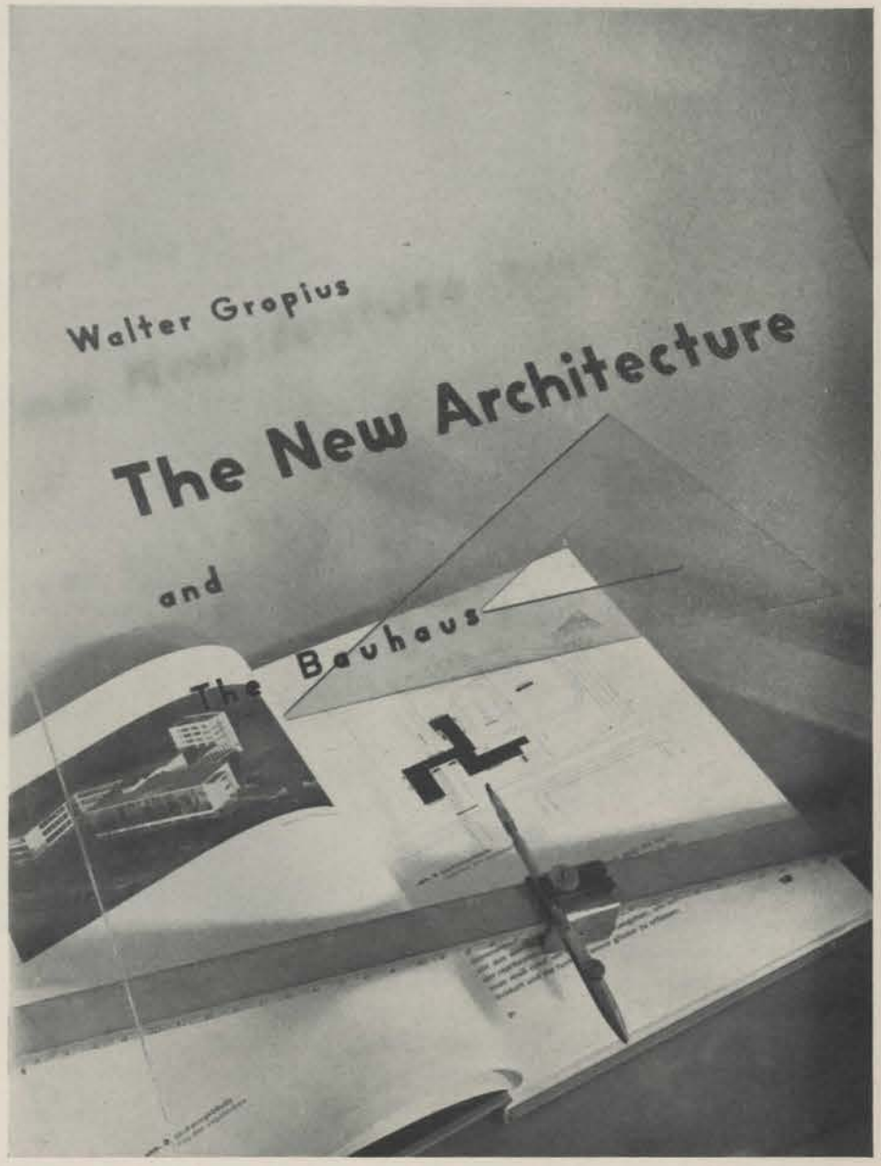


1922. Photogram — montage.

more clearly than I can tell that I was on the way to solve the problem of painting with my own means. But what is a problem? Young students often believe that the artist's problem is something scholarly and enigmatic, beyond simple feeling and thinking. In reality, a problem, seen from the point of view of the worker, can be anything, from careful observation of an event, or of its smallest detail, to the deepest intellectual penetration of any subject. The task is to translate the "problem" into a "form" which can be comprehended and absorbed by the spectator. In those days color became my "problem." Color, which I had so far considered mainly for its illustrative possibilities, was transformed into a force loaded with potential space articulation and full of emotional qualities. I started out to clarify how different colors behave when organized in relation with each other. I made dozens of *collages* with colored paper strips. Spending a holiday in the country, where from the hilltops I could see hundreds of small strips of land, I painted pictures with colored stripes in juxtaposition and called them "acres." I could have called them color compositions, but it was difficult to cut loose from the dogma that a painter is a painter only when he renders or interprets nature and that otherwise his paintings may be contemptuously labeled "decoration." Such conventions were all pervasive. Not recorded in books, they existed as an unwritten law by common agreement of professionals. It was forbidden, for example, to use black. "Clear black," it was said, "does not exist in nature. It has to be produced from red, green and blue." (Of course, this did not produce black at all, but only a kind of dirty mess.) "One should *never* use a compass or a ruler. If one makes a circle, it should be made free-hand, but it must look as though it had been made by a compass." I struggled hard against these arguments. One risked excommunication.

Influence of machine technology. In 1919, I lived in Vienna, lost among the depressed conformists of the postwar period. Coming from a farm in the agricultural center of Hungary, I was less intrigued with the baroque pompousness of the Austrian capital than with the highly developed technology of industrial Germany. I went to Berlin. Many of my paintings of that period show the influence of the industrial "landscape" of Berlin. They were not projections of reality rendered with photographic eyes, but rather new structures, built up as my own version of machine technology, reassembled from the dismantled parts. Soon these dismantled parts appeared in my *montage* pictures. On my walks I found scrap machine parts, screws, bolts, mechanical devices. I fastened, glued and nailed them on wooden boards, combined with drawings and painting.* It seemed to me that in this way I could produce real spatial articulation, frontally and in profile, as well as more intense color effects. Light falling on the actual objects in the constructions made the colors appear more alive than any painted combination. I planned three-dimensional assemblages, constructions, executed in glass and metal. Flooded with light, I thought they would bring to the fore the most powerful color harmonies. In trying to sketch this type of "glass architecture," I hit upon the idea of transparency. This problem has occupied me for a long time.

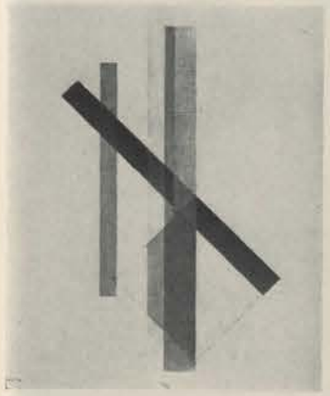
* Under the influence of cubist collages, Schwitter's "Merz" painting and dadaism's brazen courage, I started out with my photomontages, too. This led me in the same period to the rediscovery of the technique of the photogram (cameraless photography).



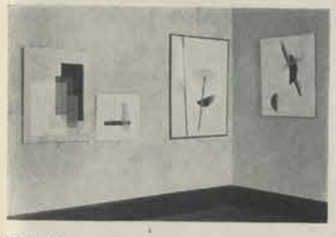
1936. Book jacket.

1936. Special effects for the motion picture "Things to Come."

1920. Glass architecture.



1921. Transparency.



1921-22.

1925. Photomontage.

The capacities of one man seldom allow the handling of more than one problem area. I suspect this is why my work since those days has been only a paraphrase of the original problem, light. I became interested in painting-with-light, not on the surface of canvas, but directly in space. Painting transparencies was the start. I painted as if colored light was projected on a screen, and other colored lights superimposed over it. I thought this effect could be enhanced by placing translucent screens of different shapes, one behind the other, and projecting the colored lights over each unit. Although at the time I was without the necessary skill and means, this idea was responsible, with some changes, for my later experiments with stage sets and with molded transparent plastics.

My "transparent" pictures around 1921 became completely freed of elements reminiscent of nature. The liberation from the necessity to record was their genesis. I wanted to eliminate all factors which might disturb their clarity — in contrast, for example, with Kandinsky's paintings, which reminded me sometimes of an undersea world. My desire was to work with the peculiar characteristics of colors, with their pure relationships. I chose simple geometrical forms as a step towards such objectivity. I see today that this step was the logical continuation of the cubist paintings that I had admiringly studied. After my earlier experiments with black and white and colored strips, with related small and large areas of different colors, I found that the cubists, in their collages, had already touched upon such schemes. To me it was disturbing that the cubists had named such pictures "Still Life with Mandolin", "Head", or "Nude". Now I realize that their clinging to subject-matter was inevitable. First, because of the convention that every painting must be rooted in nature. Second, because new developments for them took place only step by step as a result of the disintegration of the original stimulus. Tearing apart the old visual conception, the cubist painters originated a new means of rendering, as well as a space articulation. The cubists hoped to develop a method to penetrate reality more thoroughly than had been possible with perspective-illusion. They had an intimation of the coming forceful visual monopoly of the movies, and tried to escape from it by all means. The principle of the motion picture was a new method of rendering three-dimensional reality. The film was able to show any object in space from many different sides in quick succession. The cubists began to produce such a rendering by "looking around the corner," and looking from above, from every side — invalidating the monocular vision of previous painters.

In the first place, the spectator's surprise came, to a great extent, from distortions of recognizable objects and from the wit with which these deviations from the habitual rendering of nature were used for a binocular characterization of the object. Besides the emotional upheaval caused by the startling extension of the traditional pictorial elements into a *new* vision, the distortions and strange transformations of well-known subject matter produced, in addition, an attack on all pictorial fixations originating in the renaissance. The analysis of the binocular vision in motion led the cubists to render objects with a multitude of details seen from every point of view. For this they employed a method of dissolving the whole shape into small geometric units, and saw to it that the multitude of elements did not destroy the original subject as an entity. To do this clearly, the cubists devised a method of having small shapes cast shadows within the large area of the original shape. A little painting of playing-cards by Braque in 1910 shows this method — which Cézanne had already employed in some of his watercolors. When playing-cards are lying flat, they do not cast shadows, but the more the cards are lifted, the more shadow they cast.

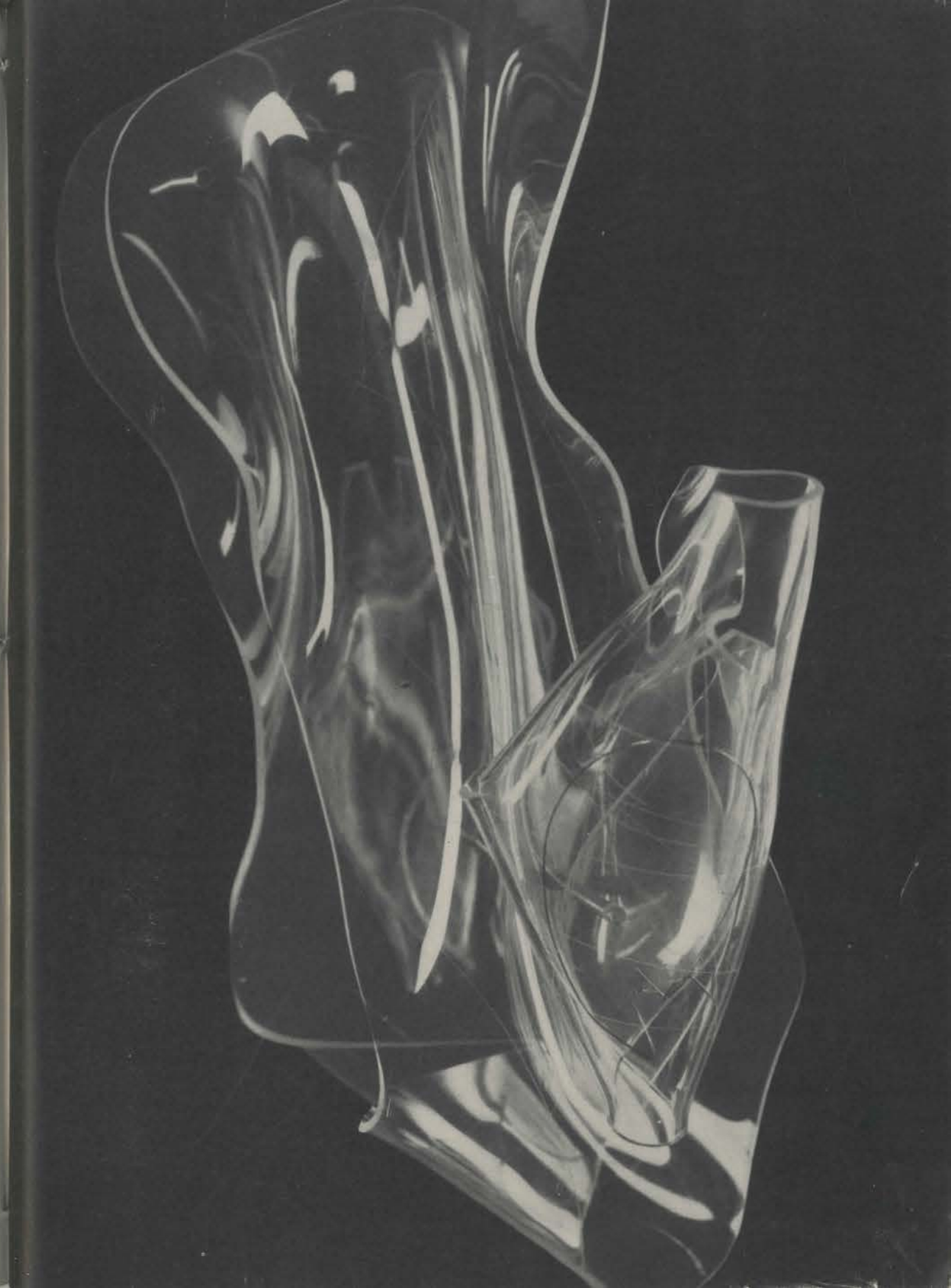
This phenomenon has been utilized in the third phase of cubism: all objects seemed to be flattened out; that is, they were simplified to their plane, elevation and section. *In order to see them from all sides,* as if one were to move around them, all these views were superimposed. But such superimpositions were rather difficult to disentangle. To differentiate between the multitude of the smaller shapes, which originated by crossing or overlapping each other, the cubists shaded either the edges or the corners of the small shapes while keeping the identity of the general theme. This departure was soon transformed into a genuine form of picture construction. There the fine shadings, similar to photographic halftones, light and dark planes, produced a new rhythm which stole the show from the original analytical intention of a better rendering of nature by a vision in motion. These paintings, especially the collages, created new rhythmic references between geometric and free shapes which were divorced almost entirely from their naturalistic origins and previous connotations, i.e., being parts of the object. This phase of the cubists' efforts, I believe, was the unconscious impetus for my own collage experiments.

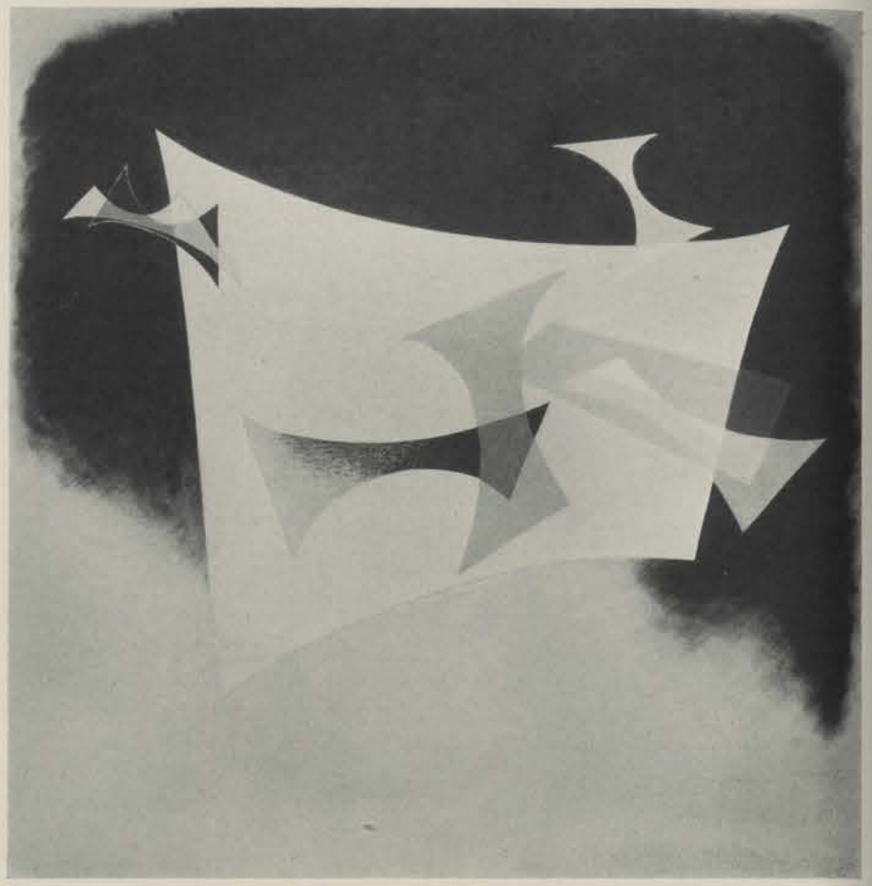
The function of the artist. Art is the senses' grindstone, sharpening the eyes, the mind and the feelings. Art has an educational and formative ideological function, since not only the conscious but also the subconscious mind absorbs the social atmosphere which can be translated into art. The artist interprets ideas and concepts through his own media. Despite the indirectness of his statement, his work expresses allegiance to the few or many, to arrogance or humility, to the fixed or visionary. In this sense, he must take sides, must proclaim his stand and no true artist can escape this task. Otherwise his work would be no more than an exercise in skill. What art contains is not basically different from the content of our other utterances but art attains its effect mainly by subconscious organization of its own means. If that were not so, all problems could be solved successfully through intellectual or verbal discourse alone.

The so-called "unpolitical" approach to art is a fallacy. Politics is taken here, not in its party connotation, but as a way of realizing ideas for the benefit of the community. Such a *Weltanschauung* is transformed, in the arts, into an organized, felt form by the concrete means of the different modes of expression. This content can be generally grasped directly through the senses, on a subliminal level, without a conscious thinking process. Art may press for a socio-biological solution of problems just as energetically as social revolutionaries may press for political action. The difficulty is that few people are sensitive and, at the same time, educated enough to receive the real message of art, whether contemporary or old. As a young painter I often had the feeling, when pasting my collages and painting my "abstract" pictures, that I was throwing a message, sealed in a bottle, into the sea. It might take decades for someone to find and read it. I believed that abstract art not only registers contemporary problems, but projects a desirable future order, unhampered by any secondary meaning, which the customary departure from nature usually involves because of its inevitable connotations. Abstract art, I thought, creates new types of spatial relationships, new inventions of forms, new visual laws — basic and simple — as the visual counterpart to a more purposeful, cooperative human society.

1940. Plexiglas sculpture mounted on chromium plate (see opposite page). Photo by J. A. Mills—W. Keck.

Objective standards. My intention was not to demonstrate only individual inventions, but rather the standards of a new vision employing "neutral" geometric forms. They should help, I thought, to emphasize the substance of relations, without being blurred



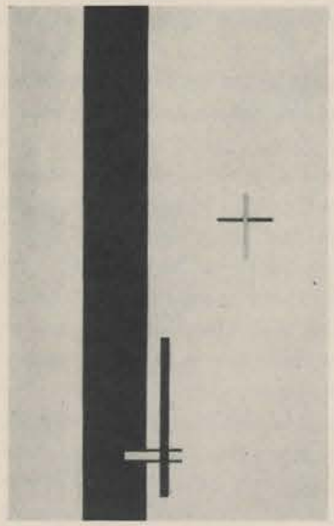


1941. Chicago Space 7, oil on canvas.

by other elements. This was emphasized even more by my smooth, impersonal handling of pigment, renouncing all texture variations.*

This involved ascetic restraint, voluntary sacrifice of advantages which had become the privilege of every painter after impressionism, and, even more, after cubism. Rich variety of texture gave those pictures a quality of *peinture* which was highly valued by the connoisseur. Textures had a double function. They began the revolution which brought about the change from traditional illusionistic rendering to "painting." The new painting did not imitate nature, but translated its manifold appearances into direct visual experience. The primary intention was to produce the visual fundamentals of picture making. Visual, not literary, relationships were created within the picture. They were a testimonial to the imagination of the painter. After a period of wavering (since I loved the qualities of texture), I came to feel that textures personify individual values, and sometimes a hypertrophic ego; that the original need of translating nature into "texture-formed" paintings did not exist after the abstract painters found a more direct and elementary way of picture-making. I gave up the use of textures.

This is the place where I may state paradoxically that, in contemporary art, often the most valuable part is not that which presents something new, but that which is missing. In other words, the spectator's delight may be derived partly from the artist's effort to eliminate the obsolete solutions of his predecessors. My desire was to go beyond vanity into the realm of objective validity, serving the public as an anonymous agent. An airbrush and spray gun, for example, can produce a smooth and impersonal surface treatment which is beyond the skill of the hand. I was not afraid to employ such tools in order to achieve machine-like perfection. I was not at all afraid of losing the "personal touch," so highly valued in previous painting. On the contrary, I even gave up signing my paintings. I put numbers and letters with the necessary data on the back of the canvas, as if they were cars, airplanes, or other industrial products. I could not find any argument against the wide distribution of works of art, even if turned out by mass production. The collector's naive desire for the unique can hardly be justified. It hampers the cultural potential of mass consumption. In the visual arts, we already have mass-produced engravings, wood-cuts, etc. My photographic experiments, especially photograms, helped to convince me that even the complete mechanization of technics may not constitute a menace to its essential creativeness. Compared to the process of creation, problems of execution are important only so far as the technique adopted — whether manual or mechanical — must be mastered. Camera work, photography, motion pictures, and other projective techniques clearly show this. It may happen that one day easel painting will have to capitulate to this radically mechanized visual expression. Manual painting may preserve its historical significance; sooner or later it will lose its exclusiveness. In an industrial age, the distinction between art and non-art, between manual craftsmanship and mechanical technology is no longer an absolute one. Neither painting nor photography, the motion pictures nor light-display can be any longer jealously separated from each other. In 1922 I ordered by telephone from a sign factory five paintings in porcelain enamel. I had the factory's color chart before me and I sketched my paintings on graph paper. At the other end of the telephone the factory supervisor had the same kind of paper, divided into squares. He took down the dictated shapes in the correct position. (It was like playing chess by correspondence.) One of the pictures was delivered in three different sizes,



1922. Enamel.

* In the old Bauhaus we called this "facture," or "surface treatment."

so that I could study the subtle differences in the color relations caused by the enlargement and reduction. True, these pictures did not have the virtue of the "individual touch," but my action was directed exactly against this over-emphasis. I often hear the criticism that, because of this want of the individual touch, my pictures are "intellectual." This is meant as a derogatory term, referring to a lack of emotional quality. But my belief is that mathematically harmonious shapes, executed precisely, are filled with emotional quality, and that they represent the perfect balance between feeling and intellect.

Colleagues. In 1922 the Russian artists, El Lissitzky, Ilya Ehrenburg and later Gabo, came to Berlin. They brought news of Malevich, Rodchenko and the movement called suprematism. The Dutch painter, Theo van Doesburg, told about Mondrian and neoplasticism; Matthew Josephson and Harold Loeb, the editors of "Broom," and the painter Lozovick, about the U.S.A. Then Archipenko, the sculptor, and Tristan Tzara and Hans Arp, both dadaists, visited us. Joseph Peters and Vantongerloo came from Belgium, and the architects Knud Lonberg-Holm from Denmark, J. J. Oud and C. van Eesteren from Holland, Frederick Kiesler from Vienna, and Walter Gropius from Weimar. Berlin was for a while the hub of the artistic efforts of Europe. *Der Sturm* of Herwarth Walden exhibited the pioneers of cubism, futurism, and abstract art and printed the work of the new poets. Already in Berlin were George Grosz, Kurt Schwitters and Raoul Hausmann, the German dadaists, the latter with tendencies to constructivism; also the revolutionary film producer, Viking Eggeling, worked there with his collaborator, Hans Richter. We often met to discuss painting and other problems. Out of these discussions developed the Constructivist Congress of 1922 in Weimar, manifestoes in the Hungarian review *MA*, of which I was then the Berlin representative, and exhibitions, all of which gave us greater assurance in regard to our work and future artistic prospects.

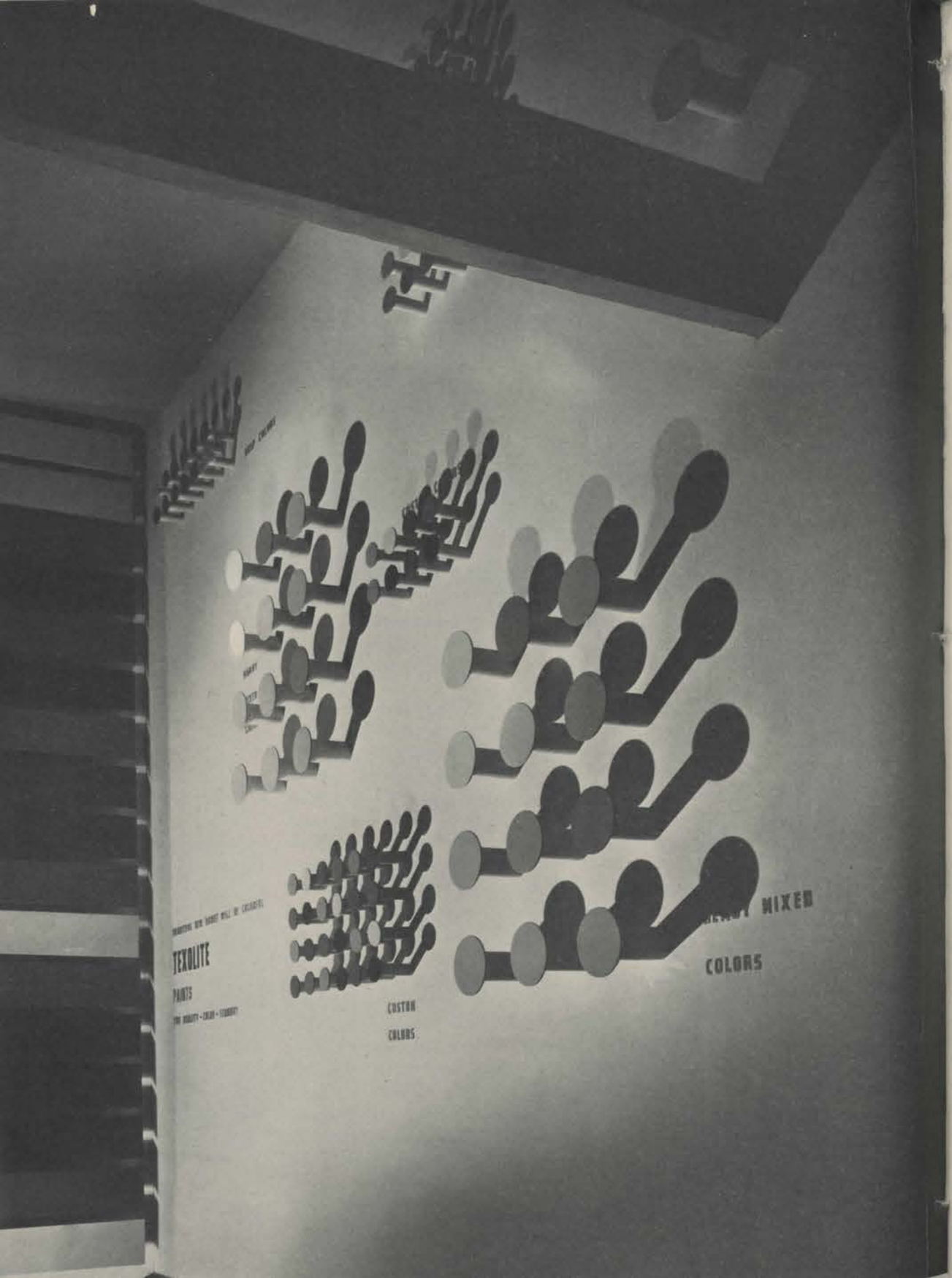
(See page 44: Nickel sculpture, 1921.)

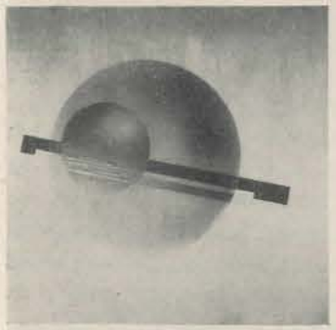
Sculptures and mobiles. Meanwhile I made sculptures from wood, glass, nickel-plated metal and other materials. I started also to work on a light display machine, a space kaleidoscope which occupied me for many years. It was a mobile structure driven by an electric motor. In this experiment I tried to synthesize simple elements by a constant superimposition of their movements. For this reason most of the moving shapes were made transparent, through the use of plastics, glass, wire-mesh, lattice-work and perforated metal sheets. By coordination of such elements of motion I obtained results that were visually rich. For almost ten years I planned and battled for the realization of this mobile, and I thought that I had familiarized myself with all its possibilities. "I knew by heart" what all the effects would be. But when the "light-prop" was set in motion for the first time in a small mechanics shop in 1930, I felt like the sorcerer's apprentice. The mobile was so startling in its coordinated motions and space articulations of light and shadow sequences that I almost believed in magic. I learned much from this mobile for my later painting, photography, and motion pictures, as well as for architecture and industrial design. The mobile was designed mainly to see transparencies in action, but I was surprised to discover that shadows thrown on transparent and perforated screens produced new visual effects, a kind of interpenetration in fluid change. Also unexpected were the mirrorings of the moving plastic shapes on the highly polished nickel and chromium-plated surfaces. These surfaces, although opaque in reality, looked like transparent sheets when moving. In addition, some transparent wire-mesh flags, having been placed between differently shaped

1922-30. "Light-prop."

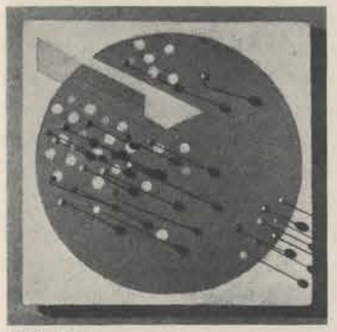
1942. Apparel shop. Photo by Hedrich-Blessing.

1944. Exhibition stand (in collaboration with Ralph Rapson — see next page). Photo by Hedrich-Blessing





1925. Aluminum, sprayed.



1935. Cork.

1935. Zellon.

1938. Rhodoid.

ground and ceiling planes, demonstrated powerful, irregular motion illusions.

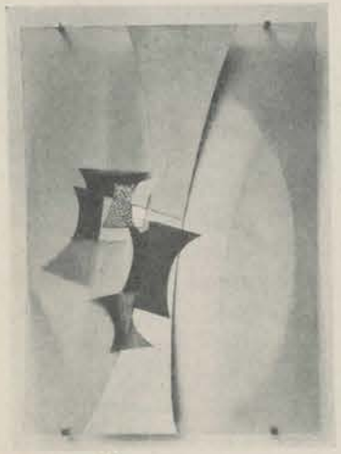
Since I gave much time to this work, I found it somewhat depressing that, for most people, the beauty of such a mobile and its emotional penetration had not been revealed. Almost no one could grasp the technical wit or the future promise of the experiment. I had more luck with a motion picture, "Light display — black and white and gray," which I made from the mobile in 1930. There I tried to translate its action into photographic "light" values.

Synthetic materials. Simultaneously with the sculptures made from metal and glass, I turned toward the new industrial materials. I began to paint on aluminum, highly polished non-ferrous alloys, and on thermosetting and thermoplastics. If I had not been afraid that these latter materials were not permanent, I would never have painted on canvas again.

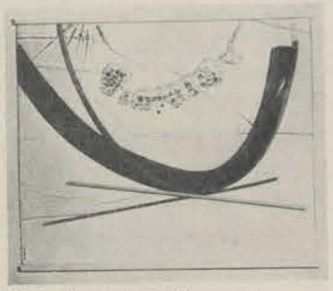
In working with these materials — uniformly colored, opaque or transparent plastics — I made discoveries which were instrumental in changing my painting technique. This had inevitable repercussions on my thinking concerning light problems. To produce true, primary relationships, my former idea of an "objective" painting, was not the only reason for my use of smooth flat surfaces. It was also nearest to the transition of light into color and color into light, something like an objective texture invention for a delicate and evasive medium. By producing real radiant light effects through transparent dyes on plastic and through other means, one has no need for translating light into color by painting with pigment.

Light painting had arrived and with it, the problem of texture reasserted itself.

Painting with light. There has been in the past a period of light painting, that of stained-glass windows. There, direct and reflected light and the shadow of the framing combined with projected colored light into a fascinating visual unity. Our technology offers new possibilities, no less impressive, and without imitating the old techniques. At present the central problem of painting on transparent sheets is the reality of direct light effects. In my first experiments I learned that I must have a screen upon which the light effects of the painting could be projected. So I mounted the painted sheet several inches in front of plain white or light gray backgrounds. There I observed that solid shapes on transparent sheets cast solid shadows. To dissolve and articulate the heavy shadows one has to employ various means. There is a possibility of scratching the surface with fine lines of different density which throw shadows of varied gray values on the screen, similar to the fine gradations of grays in the photogram. To paint stripes similar to grill- or lattice-work, or to perforate solid surfaces, is another possibility. Such elements, if lighted, cast alternating shadow and light patterns on the background *behind* the painted surface. Upon these patterns the original painting is superimposed. If lighted from the side, the shapes of the original and its shadows appear shifted, creating a new relationship between the colors and their gray shadows. This intensifies considerably the effect of the usual shadowless paintings. It produces automatically a "light texture," especially if transparent dyes are used instead of pigments. The results, although very pleasing, bring some danger with them. The smooth perfection of the plastics, their light-flooded, sparkling planes, could easily lure one into an effective but decorative performance. I attempted to avoid this, especially when remembering my Louvre and Vatican visits, where I observed the "masterpieces" of late Roman sculptors who tried to outdo each other by using expensive polished marbles, colored bronzes, precious stones, ebony and gold.



1938. Rhodoid.



1941. Plexiglas with flaw.

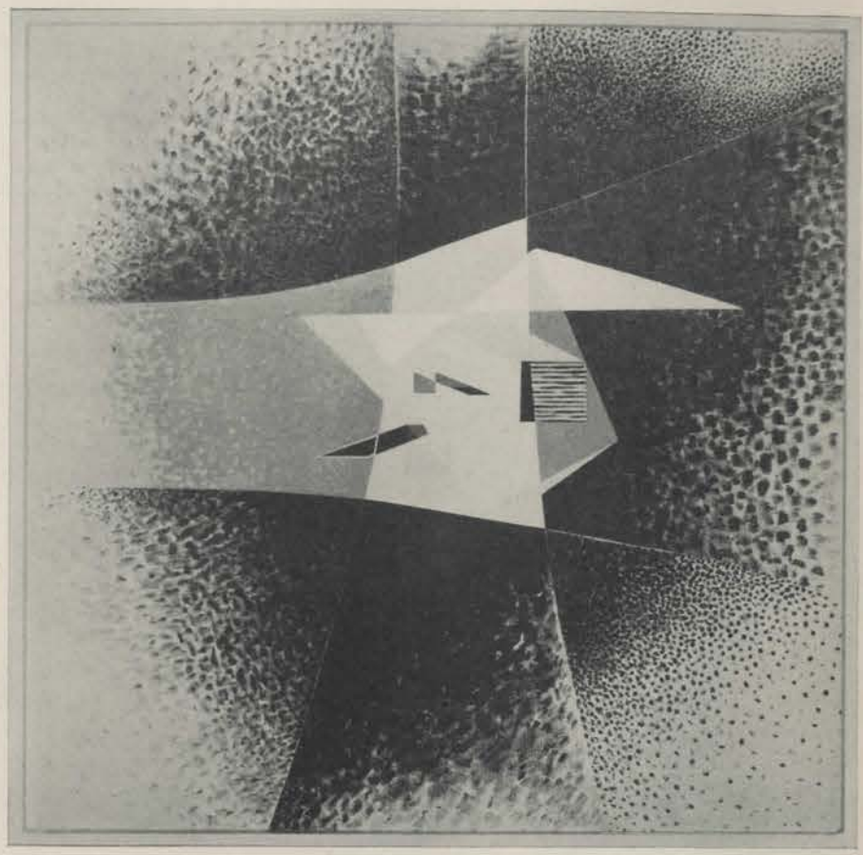
1939.

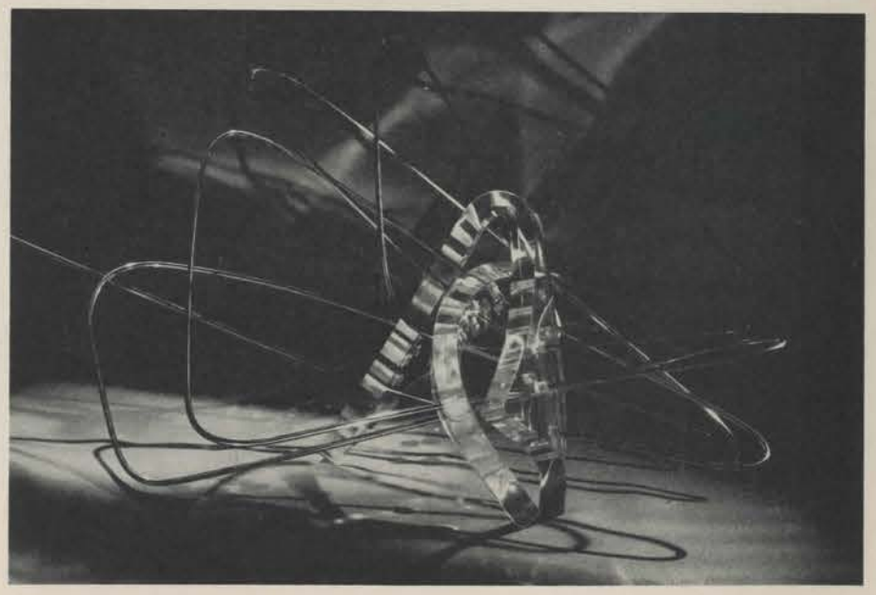
1937. Painting with spiral binding.

Though plastics are new materials, not thoroughly tested, I had the feeling that one has to work with them, in spite of the danger of pretty effects. It may take decades until we will really know the material, and before we can develop a genuine technique to handle them. Even technical problems of painting on these new materials are yet unsolved. After doubtful experiments with industrial lacquers, which were not fast, I tried to paint with oil pigments on transparent sheets. In order to avoid the danger of the colors peeling off, I scratched hundreds and thousands of very fine lines into the plastic to be painted, hoping they would hold the pigment. I covered these engraved lines with oil paint which was held in and between the little crevices. I often painted on the front and back of the sheets too, so that my attempts to create space articulation by the relationships of receding and advancing colors were enhanced by the thickness of the sheet; that is, the real distance between the colors applied in front and in back. In addition I achieved differentiations in the appearance of the same color showing through or seen on the polished surfaces. The new material also needed a specific brush technique, which led to rather unexpected textures. Later, instead of covering and filling the fine engraved lines with a homogeneous color layer, I sometimes only rubbed color into them. By certain combinations of colored hair lines and their fine shadows, intensified, vibrating color effects appeared, an iridescence which I had admired so much in thin glass vessels buried thousands of years. Translated into oil pigment, Renoir was a great master of such effects. I felt happy to achieve a similar refinement in the handling of colors by simpler means. These new effects with their emotional content and spiritual aspirations can only be grasped, however, after their "novelty" aspect has been overcome by serious consideration of the problem involved.

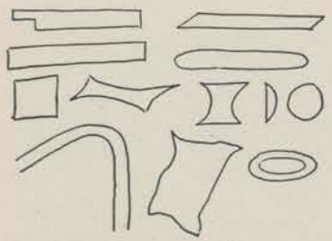
The work is still incipient and the possible combinations and discoveries, as for instance, the use of flaws and bubbles in the plastics, may lead to even more startling results. They may lead to kinetic light displays.

I often thought that my early transparent paintings were static phases of such light displays. In order to emphasize the kinetic nature of those paintings, I often repeated their central motives somewhat smaller or distorted within the same picture area. It seemed to me that with such repetition I achieved a new dynamic form of harmonious organization, not unlike the classical composition types which I had studied with great eagerness. In the past, symmetry, the golden section, and the hexagram were employed and constructed mechanically by painters. I seemed to achieve a more delicate and sensitive solution of harmony and relationships by my attempts at repetition of the elements, and by changing the sizes of the units. I later observed that by placing the shapes intuitively throughout the picture area, I produced frequent correspondence of points. I connected these points with straight lines. They appeared not only mathematically balanced, but also created a spatial network, an unusual diagram of tensions. These diagrams acted also as symbols of motion. This became less obvious but more evident by painting on transparent plastics. On such paintings by using sunlight or a spotlight, I could produce a second picture either behind the original, in the form of parallel and slightly distorted shadows, or in the form of reflections on the opposite wall. If the picture was hung in a corner and lighted from the side somewhat, this reflection became very intense, producing a strongly distorted image. Such an image was exciting because it had a natural relationship with the original painting that could not be missed by anyone, and the repetition appeared not as a boring mechanical mirroring, but as a negative image. I could obtain distorted images in other ways too. For instance, I moved the sheet into a slanting position against the background. I could then change the

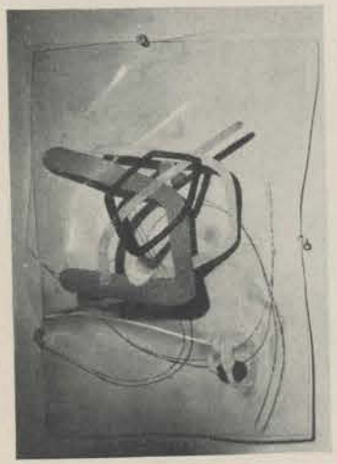




(above) 1946. Leuk I, canvas. (below) 1946. Dual form, plexiglas and chromium sculpture.



All the shapes which I used in the last twenty-five years surprised me one day as being variations of a ribbon (strip).



1943. Hand-shaped plexiglas. (See illustration, page 66.)

1940. Transparency plus!

shadow image at will and could move it sideways, up or down, depending upon the angle of the sheet and the movements of the light source. I could bend the plastics either convexly or concavely, then fasten them to the background. The shadow of such sheets produced a distorted image of the original painting. Similar effects were achieved when the observer moved in front of the painting. Also, I made paintings on celluloid sheets with a spiral binding. In these simple ways new types of moving pictures originated with ever changing shadows and reflections. My stage design, three-dimensional "lantern slides," and motion picture work grew out of the same interest, to "paint with light." I have had enough opportunity to make abstract motion pictures, black and white and in color, before that time and afterward, but I am convinced that without employing the new painters' experiments with light and color no adequate solution can be reached. In analyzing "distortion," in these days I find that during the last twenty-five years, since I began my abstract paintings, I did not paint any shape which was not the interpretation of the original departure, the strip, used in my first collages. By slight distortion, although I had not been conscious of it, I continuously changed this shape on each occasion believing that I was inventing something completely new.

Molding the plastics. The last step was the distortion of the flat plane itself. Thermoplastics, when heated, can be easily shaped. One day it occurred to me that by painting on flat plastic sheets, I neglected this essential property of the material. Thus I heated, bent, and twisted a transparent sheet after painting on it. With this manipulation I arrived at complex concave and convex shapes, rich compound curvatures which created a constantly changing relationship between the painted and engraved transparent planes and the background, resulting in a new type of "related" distortions. The bends and curves made the plastics structurally more resistant to breakage. At the same time, the bends caught high lights. They could be made a part of the light compositions themselves. These could hardly be called painting or sculpture. However, the difficulty of naming these forms should not be held against them. During the last twenty-five years I have been often fascinated by phenomena not listed anywhere. Thus I did not worry very much about a name for this unknown version of a kind of sculpture-painting. For me they were "space modulators." The distorted shapes of my "modulators" produced spatial effects, not only through the curved surfaces which were either protruding or receding, but also through the lines flowing in all directions of the weather cock, formed by the thickness of the sheets themselves. Their edges produced space curves which, when combined with similarly curved wire of the same gauge as the thickness of the edges, could be blended into a complete row of space cells. They were partly made of transparent plastics, with emphasis on the edges, partly of wire and air "walls," which were "more transparent" than transparency itself. These experiments can be seen as related to the spatial quality of endlessly bent tubular furniture. I liked these tubular structures and I had many ideas for their use in other structural and architectural experiments. I tried to achieve similar effects with painting on canvas. There the free "motion" forward and backward of color prepared a new type of spatial perception. This was in clear opposition to the renaissance method of producing illusionistic space by the illusionistic relationships of volumes. In this way my experiments seemed to become a part of the general tendencies of contemporary painters. Many of us have departed from the old canons and obsolete conventions, to a new space articulation, trying to define intuitively and to satisfy more adequately the specific need of our time for a vision in motion. Chicago, 1944.

1946. Wire sculpture.

Obituary note by Walter Gropius

With Moholy-Nagy's untimely death a life of tremendous vitality, will power and love has been cut short at its zenith. When a beloved friend irrevocably disappears into silence, the sudden loss enlightens our consciousness in a flash so that we recognize the truth more clearly than before.

Moholy-Nagy has bequeathed to us a wealth of art works and writings, which embrace the whole range of the visual arts. We might call the scope of his contribution "Leonardian," so versatile and colorful has it been. He was successful at once as a thinker and as an inventor, as a writer and as a teacher. This would seem to be almost too vast a field for one man to till, but abundant versatility was uniquely his. With his power of imagination he kept this tremendous variety of interests in balance. His vision took brilliant shortcuts, synchronizing his observations into a consistent whole, for he felt today's danger of over-specialization which leads to fallacies.

Constantly developing new ideas, he managed to keep himself in a state of unbiased curiosity, from which a fresh point of view could originate. With a shrewd sense of observation he investigated everything that came his way, taking nothing for granted, but using his acute sense for the organic.

I remember his peculiar freshness when he was facing a new problem in his art. With the attitude of an unprejudiced, happy child at play, he surprised one by the directness of his intuitive approach. Here was the source of his priceless quality as an educator: his never-ceasing power to stimulate and to carry away the other person with his own enthusiasm. Can true education achieve more than setting the student's mind in motion by that contagious magic?

This book, which has proved to be "the standard grammar of modern design," gives broadest evidence of the decisive part which Moholy-Nagy has played in the history of the visual arts, for it has revealed a new mental attitude in contemplating, observing and forming this, our physical world. It will gain in time when weaker eyes have learned to see through his.

Index: Figures denote pages. Figures with asterisks denote illustrations.

Vision in Motion by L. Moholy-Nagy

Of all contemporary artists who have received world-wide recognition none is more versatile than L. Moholy-Nagy. Herbert Read, well known art editor of London says: "As a painter, typographer, photographer, stage-designer and architect he is one of the most creative intelligences of our time." Certainly, no one is better qualified to write this great book of our time, which may well become the blue-print for education through art. A pioneer-participant in the modern artistic and intellectual movements in Europe, Moholy presents in this, his latest book, the essence and summation of his philosophy upon which the educational program of the Institute of Design in Chicago is founded.

In clear understandable language, devoid of unintelligible phrases, Moholy clarifies the relation of modern design, painting, literature, architecture, the cinema, science and industry. He makes the most thorough inquiry thus far attempted into the space-time reality of modern man and his emotional existence. A strong advocate of the interrelatedness of all human activities Moholy makes a passionate plea for the integration of contemporary art, technology, science and social plannings with life.

In the belief that the most forceful statements are provided by illustrations the author amplifies his text lavishly with pictorial material, among the illustrations there is a large variety of media and subject matter such as industrial design and advertising art; contemporary painting including cubism and abstract art; photography, photograms, photomontages, collages and shots from motion pictures; sculpture, architecture etc.—all examples by the best exponents in the various fields.

The book will furnish many readers with a contemporary thinking attitude toward art and life, and with a new insight into the reason for modern art. It is recommended for general reading without reservation.

376 pages 476 illustrations — many in color. Typographical design by the author. Bound in cloth. 8½ X 11. $10.50. Published by Paul Theobald, Chicago.

Other Books and Prints published by Wittenborn, Schultz, Inc.

André Masson: Mythology of Being. A poem, eight pen and ink drawings and a frontispiece. 200 numbered and signed copies. Large portfolio. 1942. Copies Nos. 1 to 30, with one additional original etching.

Georges Seurat by John Rewald. With 101 plates, 4 in color. Large 8vo. Rev. ed. 1946.

Georges Braque by A. E. Gallatin. With 12 plates and a color-facsimile. 1943. 450 copies.

Georges Braque: Still Life, 1913. A color-facsimile reproduction in the original size, oval. 1943. 150 copies.

Ambroise Vollard: Editeur, 1867–1919. An appreciation and catalogue by *Una E. Johnson.* With 37 plates. 1944. 300 copies.

Line . . . Form . . . Color. Five woodblock color prints by *Louis Schanker.* Foreword by Carl Zigrosser. Large portfolio. 1944. 25 copies on Chinese rice paper.

Duchamp's Glass. An analytical reflection by *Katherine S. Dreier* and *Matta Echaurren.* With 5 plates. 8vo. 1944. 250 copies.

David Burliuk by Katherine S. Dreier. Foreword by Duncan Phillips. With 53 plates. 1944.

Rainer Maria Rilke: The Sonnets to Orpheus. With nine engravings by *Kurt Roesch.* German-English text, M. D. Herter Norton translation. 35 numbered and signed copies on handmade paper from Arches, France. Folio. 1944.

Of Art . . . Plato to Picasso. Aphorisms and observations. Edited with contributions by *A. E. Gallatin.* 62 pp. 12mo. 1944.

W. R. Valentiner: Origins of Modern Sculpture. With 139 illustrations. Large 8vo. 1945.

Henry Moore: Shelter Sketch Book. With 80 illustrations. Large 8vo. 1945.

Paul Klee. A portfolio of ten color collotype plates of paintings. Introduction by George Schmidt. 1946.

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