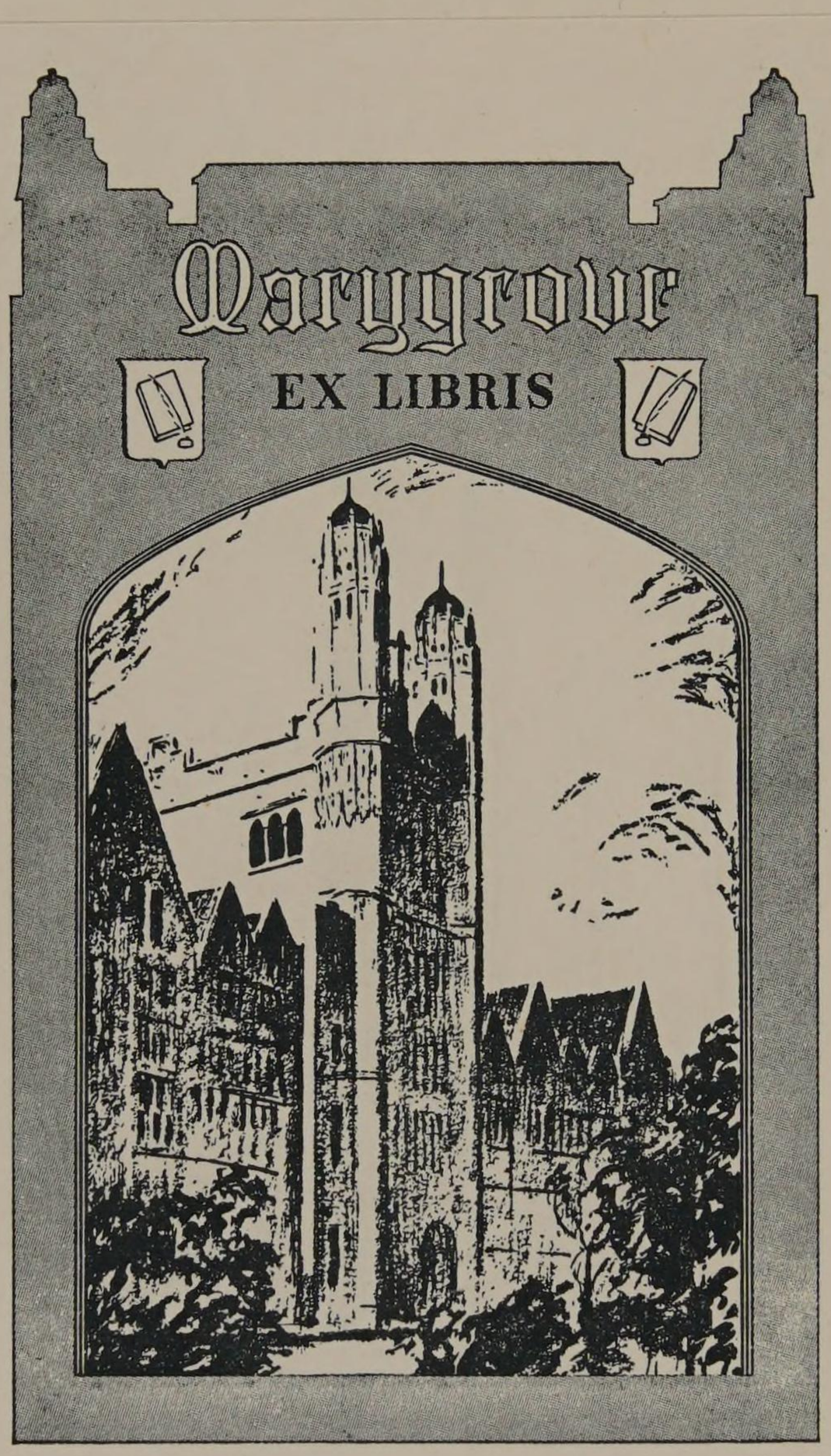

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THE SCULPTOR'S WAY

A Guide to Modelling and Sculpture

THE SCULPTOR'S WAY

A Guide to Modelling and Sculpture

BY

BRENDA PUTNAM, N. A.

Fully illustrated with plates and diagrams



WATSON-GUPTILL PUBLICATIONS, INC.

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First Revised Edition

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TO

MY FATHER

HERBERT PUTNAM

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BRENDA PUTNAM

Photo by Mina Turner

INTRODUCTION

MADAME DE STAËL once wrote of some superb monument that it was "une musique continuelle et fixée." Possibly inspired by her, the philosopher Schelling later coined for architecture the felicitous phrase "Frozen Music."

We may just as truly think of sculpture, also in the service of the Muses, as a kind of music, forever playing, though "fixed." Or perhaps we may as aptly apply to sculpture the epithet: "Frozen Poetry." For the sculptor, like the poet, is an observer of life —of all life. He observes it sympathetically and keenly, strives to fathom its inner meaning, and to express that meaning in a compact and rhythmic creation epitomizing the experiences and aspirations of mankind.

However this may be—whether frozen music or frozen poetry—sculpture should be fundamental. It is always found at the beginning, the foundation, of each new era of cultural development. When it expresses itself most spontaneously and convincingly, it is the voice of the people, the common language of humanity. So long as it remains thus simple and forthright, it is universal in its appeal. But as the sophistication of each of these eras increases, sculpture, too, becomes elaborate and self-conscious. It loses its fine earthiness. Corruption sets in and the art gradually wanes as the particular civilization wanes, lying dormant until another great surge of human need and aspiration arises.

The briefest study of history shows this. Throughout the very early civilizations—the Mayan, the Aztec, the Egyptian, the Assyrian—sculpture was the silent yet eloquent expression of the religious faith, the hopes and fears, of the people. By studying their sculpture we understand their *ethos*.

It is through their sculpture and architecture that we learn the long and magnificent history of the Egyptian dynasties; and in the same way we come to realize the glories of Greek civilization. But both in Egypt and in Greece we see the tragic falling off, the decline born of *too much*. Roman history tells the same tale of degeneration born of excess.

The Dark Ages come—the trough of the wave for man and art alike—until, in

the service of the Church, sculpture once more is found expressing—naïvely and haltingly at first, but with supreme conviction—the beliefs and aspirations of mankind. Sculpture and architecture, in perfect harmony, mature to greatness. The cathedral becomes "The Word in Stone," its carvings are the people's Bible. Gothic sculpture triumphantly reaches the top of the wave. Intrinsically it is perfect, because it carries its message straight to the heart of the common people; it has reason for being; it is a part of their lives.

Thus, created at first solely as an expression of religious faith, sculpture remains closely allied with the Church throughout the earlier part of the Italian Renaissance. Then come two great changes: the printed book and the rediscovery of Greek art. "The Word" need no longer be laboriously carved in stone, for he who would may read and does read. Powerful and worldly princes rule the Church. Discoveries of classic art stimulate the advancement of technique among the sculptors, but at the same time undermine their simple faith. Sculpture during the late Renaissance becomes less and less the voice of God speaking to the people, and more and more the luxury of the very rich. It becomes an embellishment of life. It slips once more down into the trough of the wave.

But the sea of history is vast. It has many waves. While sculpture floundered in the depths, music and literature climbed to the heights. There they rode triumphant from the 17th to the 20th century. And what of sculpture? I think one may truthfully say that it lay submerged, uncreative and unheeded, throughout those three centuries. Alive, yes, but impotent.

Then out of the soil of France arose a peasant genius. His sturdy and adventurous spirit rebelled at the fatuous insincerity and imitative neoclassicism of the academic schools. "Go back to *nature!*" he shouted. "What you are doing is not true, it is not honest. I will not degrade myself by doing it." At first, his was a voice crying in the wilderness. No one listened. He was denounced as a charlatan by the academicians.

But the people finally heard his voice. Rodin had a message for them. His "Penseur" was a man like themselves, grimly wrestling with problems like their own. And the poetry of his marbles stirred their imagination like music. *Nature* was his religion; a religion broad enough to include pagan and Christian, mystic and agnostic alike.

It was Rodin who rescued sculpture and set it on its way. But like his mighty predecessor Michelangelo, he stood alone. He belonged to no school, he founded no

school. Even now, but a short twenty years after his death, sculptors are rapidly forgetting the debt they owe him, so fast has the old order changed and new events, new ideas, new names, have come crowding. And the people—the laymen, partners of the artist—what of them?

Rudely jolted out of the security of centuries by the World Wars, a great number of European artists of the 20th century—poets, painters, musicians, sculptors, writers, architects—have been dashing about like distracted ants, their soft, comfortable home crushed and trampled by the great blundering foot of a passer-by. Clinging first to one ism and then to another, they have so completely bewildered the average layman that he stands dazed before their fantastic creations, crying, "But what do these weird things *mean?*" And the artist, too concerned with his own inner experiences to care about the layman, shrugs his shoulders and replies, "Oh, never mind! *You* wouldn't understand."

How far can any art thus travel, cutting itself off in superior isolation from the rest of mankind? I do not believe that these extremely radical elements in the arts can long survive. They are bound to be ephemeral, yet in their little day they have undoubtedly done art a real service by stimulating its sluggish circulation and by pointing out some new paths of investigation which may well lead to soul-stirring discoveries.

It is a fortunate thing for America that another vastly different element is also at work in the field of art. A growing number of young sculptors, many of them but a generation removed from humble peasants and tillers of the soil, are beginning to speak. And what they have to say is couched in simple language, the language of the man on the street. Will the man listen? History assures us that he will, provided that what he hears rings true, tallies with his own experiences, and invests those experiences with the heart-warming glow of appreciation and understanding.

So far, the great weakness of these young artists lies in a vocabulary of such limitations that what they say belongs in a child's primer, in words of one syllable. I fear it is not yet quite interesting enough for the average intelligent man of today. These earnest young artists are also portentously solemn; they persist in looking mournfully at the drabbest and most uninspiring side of life. They portray only that side. They seem to forget that life, particularly the life of today, is an extremely complicated affair, with as many phases as there are people to experience them. If the sculptor is to speak to more than just a handful of his brethren, he must enlarge his horizon.

If the sculptor is again to lead us to the heights, he must be broadly human. He

must not limit himself to the providing of caviar for the epicure, or black bread for the starving peasant. The sculptor, as poet, must have a wide vocabulary to choose from if he hopes to find the significant words that will attract and hold the attention of his hearers. He must have a mastery of form, an innate sense of rhythm, an ability to vitalize the telling of his own thought or emotion so that his reader lives it with him. His imagery must be vivid, his climax forceful, his subtle allusions full of infinite suggestion.

All these things imply learning and necessitate study. Only through mastery of his materials and his technique can the artist achieve the seemingly unstudied and spontaneous effects to which we give the name art. Technically speaking, sculpture is one of the most difficult of all the arts. It cannot be learned in a day, or a month, or a year. Mechanical problems, aside from purely aesthetic ones, are formidable. They can be overcome, but only by patient toil, guided by experience.

To sum up such experience, not merely the single and personal experience of my own thirty years of practicing and teaching sculpture, but the time-tested experience of the vast army of creative artists of the past, is the aim of this book.

Sculpture is the least understood of all the arts, and the student must frequently grope his way unaided along a dark and unfamiliar road. It is a long road, with many a steep hill to climb and many a precipice to skirt, but it is a glorious way, leading through the most beautiful scenery in the world—and to what a goal! My hope is to help the student over some rough spots, indicate a short cut here and there, lighten the way through the deep woods and point out for his encouragement the footsteps of others who have traveled the same road and have reached their goal.

If we can only get together—sculptors, students, teachers, architects, art critics and art lovers—what a gay and inspiriting band of wayfarers we shall be!

THE SCULPTOR'S WAY

CHAPTER I

PREAMBLE

THIS book is for the student, but the word student embraces many different types of searchers after truth.

There is, for example, the student working in the sculpture class of a large art school. Too often, the only instruction he or she receives is the weekly or biweekly criticism of the instructor. Such criticisms, no matter how conscientiously given, are necessarily brief. They are bound to be limited in their helpfulness. The master usually has time only to point out the pupil's mistakes; rarely does he have time to demonstrate how these may be corrected.

Here then, the purpose of this book is already twofold: I hope that for the student it may supplement, to some extent, the teachings of his master, and I hope that it may relieve the master of the necessity of spending too much of his limited time explaining and demonstrating basic technique.

The first few chapters are not, I think, too difficult even for the child, the absolute beginner. Whether or not he may later turn to sculpture as a career is not of vital importance. The main thing is that modelling will open his eyes to the myriad forms and beauties of nature.

The later and more advanced chapters will probably be most useful to a rather special class of student: namely, the girl sculptor. She has, as yet, no way (except possibly through expensive private lessons) of augmenting her art school studies by apprenticeship in a sculptor's studio. Such apprenticeship is the boy sculptor's college education. There is, unfortunately, no such college for the girl. Once she has graduated from the modelling class she must complete her training alone, with most of the vital technical problems of her profession still to be learned. Small wonder that the *sculptress* (a horrid term, which will never again appear in these pages) so often lags

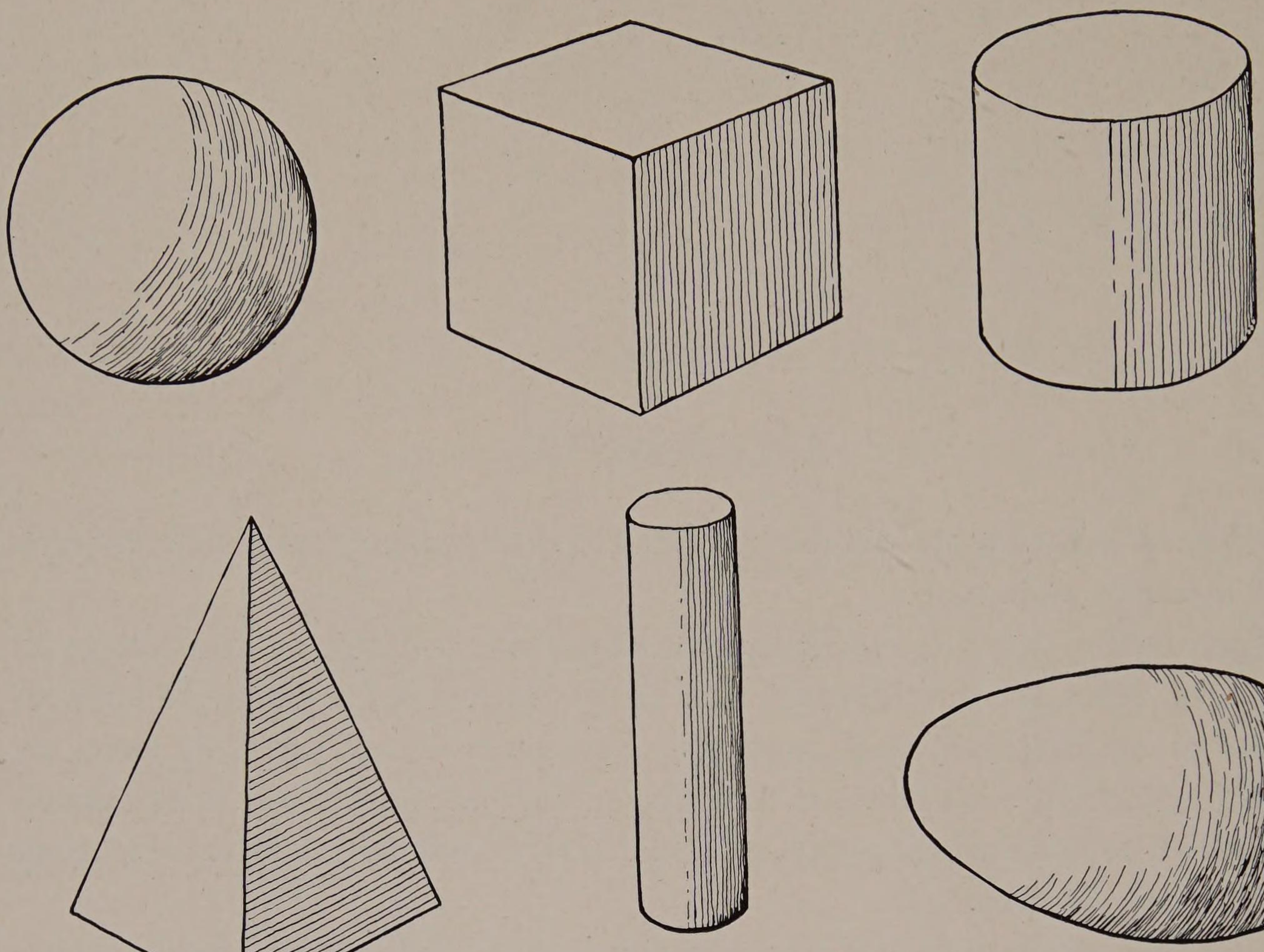


Diagram 1

behind the sculptor in mastery of her medium, even though her ideas are just as good as his!

And finally there is the layman—the appreciator of the art of the world. How often he yearns to do what his friend the artist does! How wistfully he says: "If only I'd had the time, the opportunity of trying my hand at sculpture! But it's all a mystery to me. I haven't the faintest notion how you do it. I can only appreciate it after it is done." Should he not also be given a chance? I believe he should. There is no better way to spread the understanding of an art than by showing the layman how it is done. He who does not like sculpture is he who does not know it. Thomas Whitney Surette once said, apropos of a kindred art: "No one can say, 'I don't *like* Beethoven'; all he can truthfully say is, 'I don't *know* Beethoven.' "

The actual creation of anything, be it a poem, a piece of music, or a piece of sculpture, is one of the most inspiring experiences of mankind. To take a clod of earth in

one's hand and from this lump of inert matter to fashion an object that even remotely suggests something we love, is to feel (and I say it in all due reverence) that one is a genuine, if infinitesimal, partner of the Great Creator.

Although today the artist who models in clay or plasteline, and never attempts the sterner medium of stone, is called a sculptor, the term is somewhat misleading, for sculpture actually means a carving. What most of us do is to model. Yet here again the term is decidedly ambiguous in an age when newspapers report that society leaders "model" for charity by parading about in fine raiment. Someday we shall have to coin a new word to describe what we do—some word which shall comprise the two very different techniques of carving in stone and building up in clay. There is no question but that the artist should be able to do both, and the aim of this book is to prepare him for work in all media, from the softest clay to the hardest granite.

But as carving is slow work and hard, both technically and physically, we begin our study of form by modelling. After all, the world's greatest carvers, from the old Egyptian masters to Michelangelo, all made their preliminary models in clay or wax; so we shall begin as they began, even though at first our results are hardly the same.

PRIMARY FORMS AND FIRST STUDIES

How to Begin

Has it ever occurred to you that all the forms in nature, indeed all shapes that man can see, are based upon some form of solid or plane geometry? If not, let this be our first lesson. In Diagram 1 we find a few of these forms. Of the six shown here, the ball is probably the most fundamental, for it is not only the shape of our earth, but that of the sun, the planets and the stars. And, for all we know, it may be the shape of the entire universe. Equally, it is the basis of humbler and more familiar things, from the human head to a pea in a pod. Prisms and all sorts of crystal forms are found in the bowels of the earth and in the snowflakes that fall from the sky. And the cylinder? What is a tree trunk? What are our arms and legs but jointed and somewhat modified cylinders? Indeed, the body is composed entirely of geometrical units, as you shall see later. No form in nature can exist without them.

Isolated, these forms may seem to have little charm or interest, but the moment we group them together, they stir the imagination and begin to suggest things that we have seen (Diagrams 2 and 3). In Plate 1, I have modelled three basic forms—a ball,

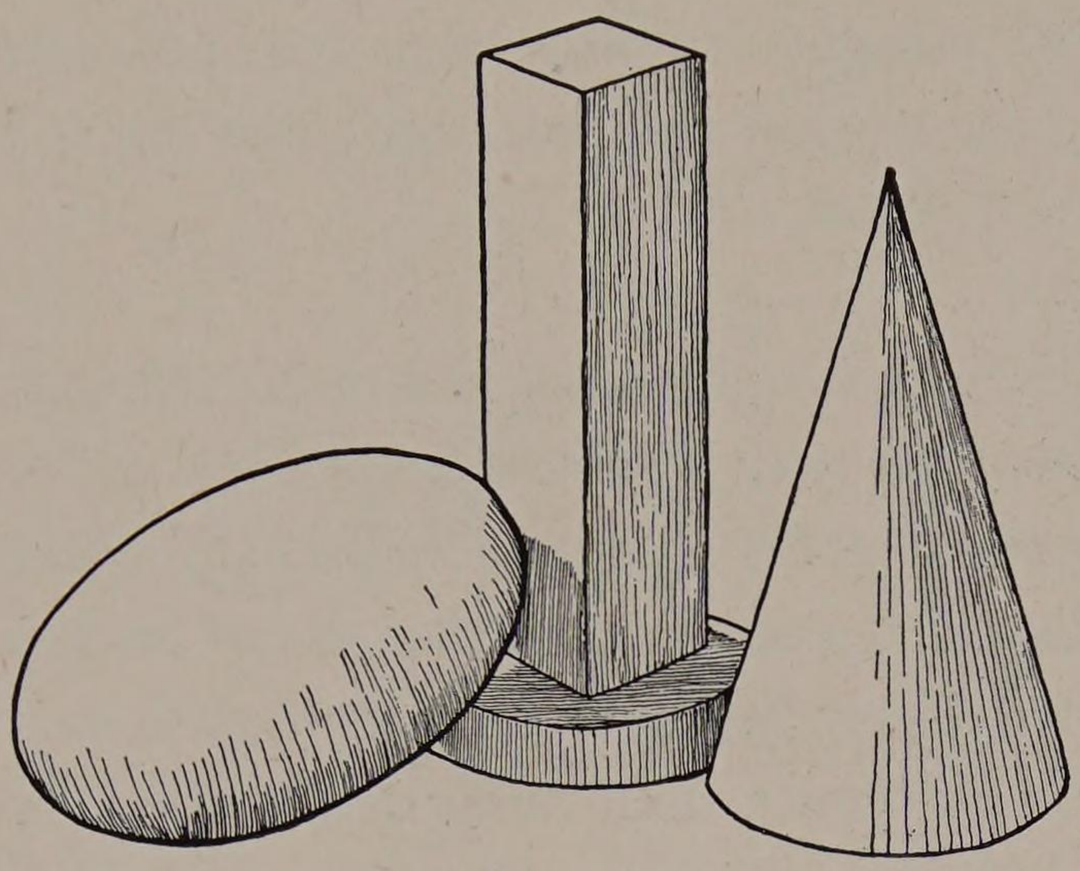


DIAGRAM 2

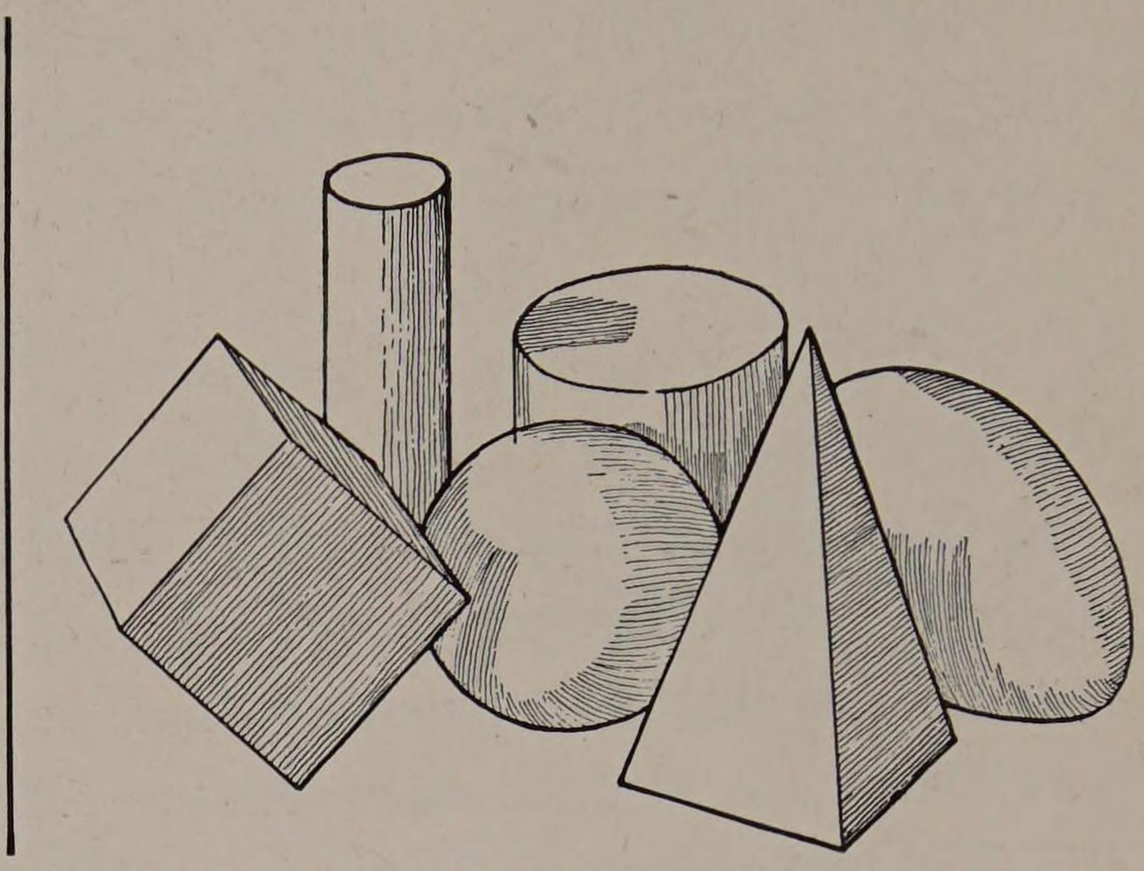


DIAGRAM 3

a cone and a modified cylinder. Call it, if you like, a cubistic interpretation of what I was studying: an apple, a pear and a banana. (Plate 2 shows a literal interpretation of the same subject.)

I know of no sounder way for a student to begin than by modelling fruit forms. Not only are they simple and beautiful in themselves, but they are eminently practical: they are mostly of a convenient size, they retain their shape long enough to give ample time for study, they are inexpensive and can be bought anywhere.

"But," argues the impatient student, "they're so stupid! *I* want to learn to make portraits of my friends, and to make pretty figures of dancing girls and lifelike things."

Tell me, did you ever hear of a musician who couldn't play his scales? Who did not have to spend hours, days, weeks and months learning how to use his hands by drilling on "five-finger" exercises? Does he begin his studies with Schumann's "Carnival" or a Liszt rhapsody? Hardly.

It is curious that a great many people who, when it comes to music or other arts with which they are familiar, readily agree that the mastery of such arts is a long and difficult process, yet seem to think that sculpture is in another category. They "love to dabble in clay," decide to "take up" modelling and blithely expect that with a few lessons, in a few weeks, they will become sculptors. Even the earnest student is frequently handicapped at the outset by admiring parents who think that whatever he or she does is wonderful. Then there are the aesthetic friends who plead: "Express yourself! That is all that matters." "Don't study with anyone. If you do, you will lose your individuality."

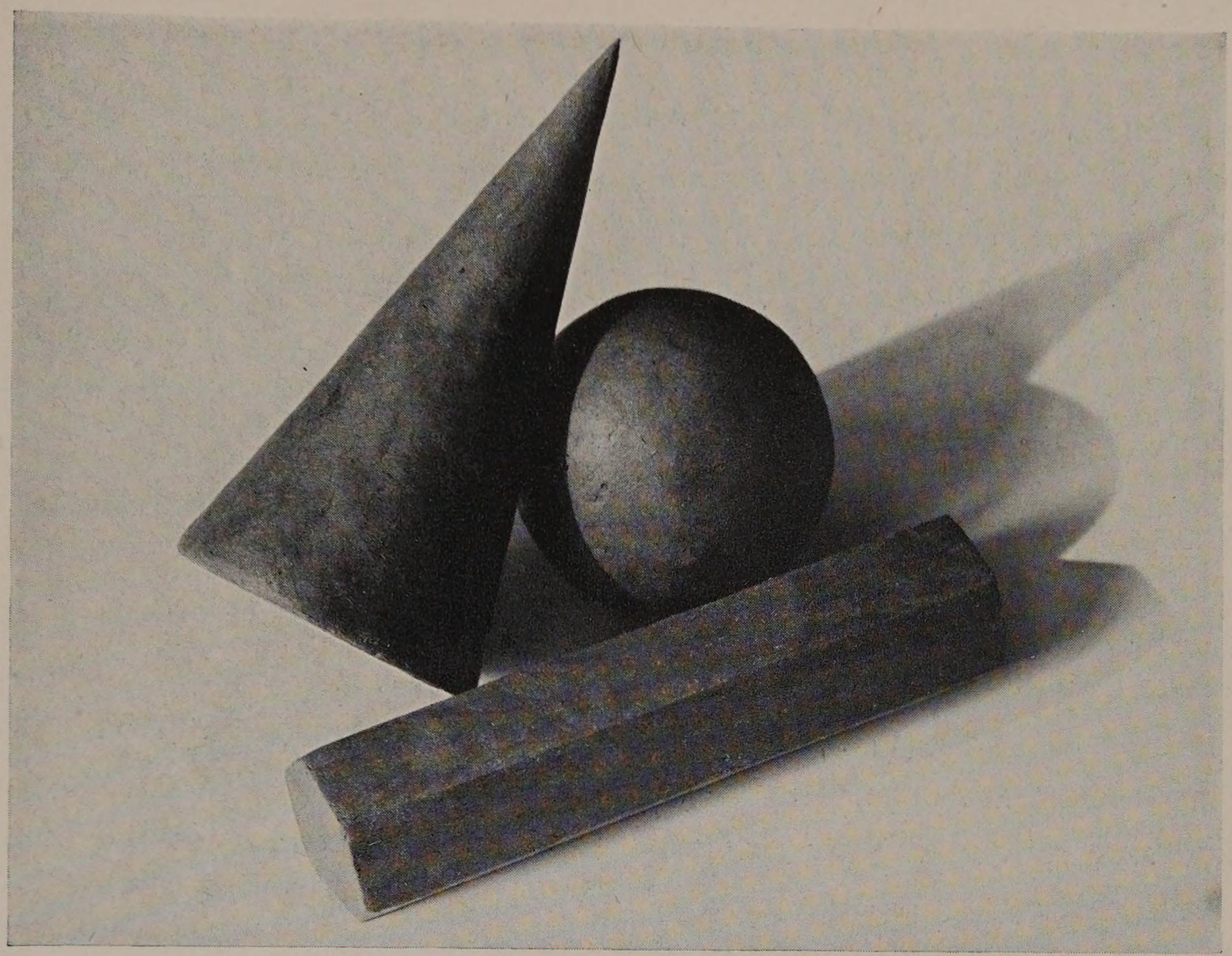
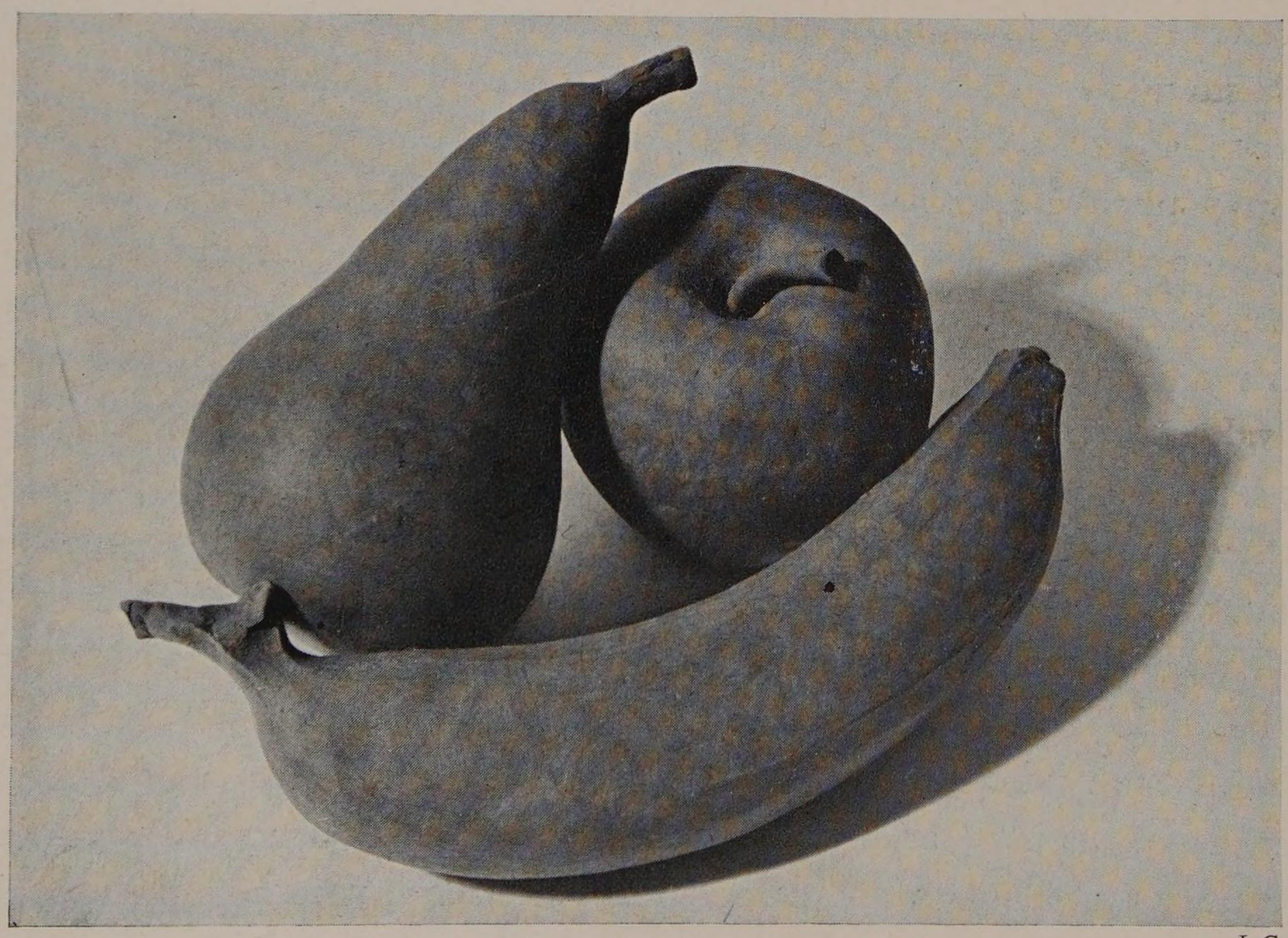


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PLATE 1. Geometrical Forms



L.G.

PLATE 2. Natural Forms

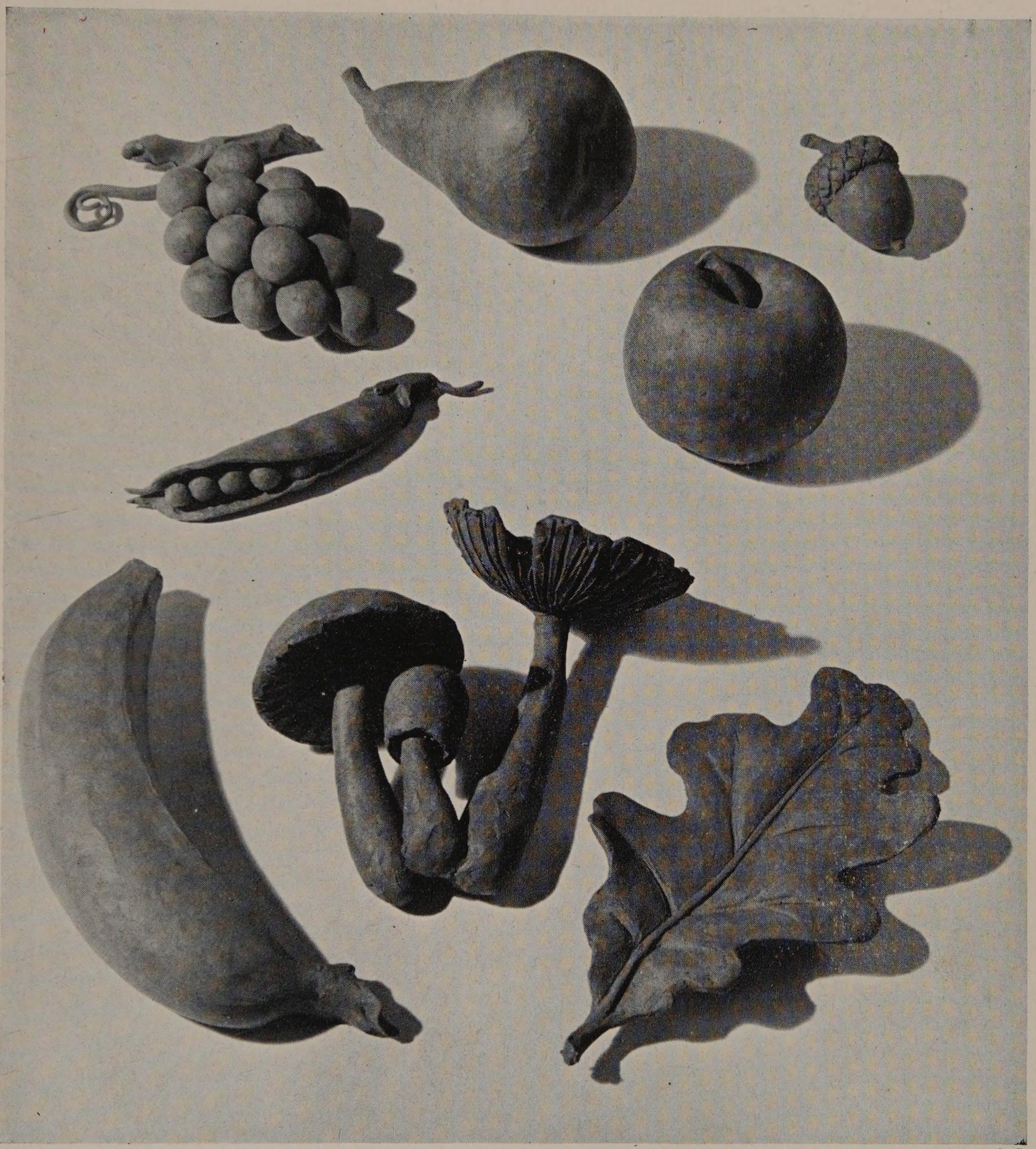
As though any art could be mastered without study! Did Donatello, Rodin, Meštrović, Bourdelle never study or learn their "scales and five-finger exercises"? Did they lose their individuality through study?

You who are about to commence your first exercises in clay may be interested to know that Rodin, whom the world thinks of as a turbulent and unfettered innovator, impatient of tradition and restraint, spent five long years of his apprenticeship with an "ornamental" modeller, doing nothing whatever but garlands—leaves and flowers and fruit such as you are to interpret in your first studies. "I have never regretted those years," he said, "they taught me to see form and to appreciate nature."

Let us then waste no more time debating whether or not we should learn our ABCs, but plunge at once into the fascinating art of modelling. It looks like fun and it is fun, in spite of all its difficulties. You need no expensive paraphernalia for these first exercises. A smock, a kitchen table, a few pounds of prepared clay or plasteline and your model, the fruit. Modelling clay, mixed ready for use, can be procured in ten- or fifty-pound cans or in barrels, from firms in most large cities. In New York, most sculptors get theirs from the Stewart Clay Company or from A. J. Ettl. All clay needs considerable handling and kneading before it is in condition to model with, and the sculptor usually prepares a convenient supply of "bats" of well-worked clay, about a foot long and an inch or two thick, before he begins to model.

No American plasticine has as yet been invented that is as satisfactory to use as the Italian plasteline, which comes in two-pound paper-wrapped "bricks." It, too, should be broken up, or sliced over a taut wire, for convenience in handling. Clay is the pleasantest material to work in, but it is a bother to keep it just the right consistency, neither too hard nor too soft. You must have plenty of soft, wet rags to wrap it in between lessons, and a sheet of lightweight waterproof material over the damp cloths, or the clay will harden in a few hours. Plasteline, being mixed with oil instead of water, never varies in texture, but stays malleable for years on end. It costs more than clay, but can be used over and over again indefinitely. The fruit and leaf studies in Plates 2 and 3 were made in plasteline, while the figure in Chapter VI was made in clay.

The apple is perhaps the best fruit to start with. Place it on the table near a window and not too far below the level of your eye. Take a piece of clay somewhat smaller than the apple (for modelling is a process of building up and adding to) and, holding it in your hand, begin adding small bits of clay. *Turn* both the fruit and your clay model every moment or so, so that no part will be neglected. There is individuality



L.G.

PLATE 3. Natural Forms Interpreted in Clay



Photo by Ernestine Shepard

PLATE 4. Vegetable Forms

even in an apple, and one side will be more flattened or more rounded than another. Occasionally place your clay apple beside the real one, then stand off and compare them critically. Is yours the same size, or is it still too small? Give your eye its first lesson in gauging size and shape.

Your first instinct will probably be to *smooth* the surface of your work long before it is fully modelled; this you must *not* do.

Let this be your first "Don't." Write it down and pin it up on your studio wall, so that it will catch your eye when you find yourself smoothing your clay (what we sculptors call "slicking") before you have built up your form completely. The temptation to slick is great and it is an almost universal fault among beginners, but we oldsters know the pitfalls of slicking and warn you at the outset. *Pit*falls is indeed the proper word for this naughty instinct, for the actual result of it is not to make your work look firmly rounded, but to skim slimily over the mere surface, leaving all the carelessly modelled "pits" in your work showing just as plainly as ever. Instead of pulling the fingers *across* your clay, you must press *down* with them. Instead of drawing a necessary bump down to fill an unwanted hollow—robbing Peter to pay Paul—take more tiny pellets of clay and press them firmly into all the irregularities. For making the veins in the oakleaf, or the crisscross pattern of the acorn cup (Plate 3), you will need some sort of tool—an orange stick, a dull penknife, or a wire hairpin will be quite adequate for such details.

When you are sure that your form is correct and clearly stated, you may, if you wish, eliminate the rough edges of the pellets by a light touch or two, but many sculptors prefer to leave their surfaces fairly rough. Notice how much of the fine sculpture illustrated in this book (Meštrović, Andreotti, etc.) has a very rough, free surface, which catches the light in a lively way. If the type of work you prefer is rather such pieces as Archipenko's "White Torso" or Harriet Frishmuth's "Speed," do not imagine for a moment that this eggshell surface was achieved in the clay. This was done later by rasping and sandpapering the plaster after the sculpture was cast.

Textures are, however, at present, unimportant. The *shape* of things is all that matters. Work always in a clear strong light that throws plenty of shadow on your model. For it is the shadows that make the form visible. What is sculpture but light and shade? It has no outlines, any more than the fruit you are copying. Pause frequently as you work and analyze just what it is that you see in your apple besides the color. Place the fruit so that the rich modelling of the dimples at top and bottom is clearly

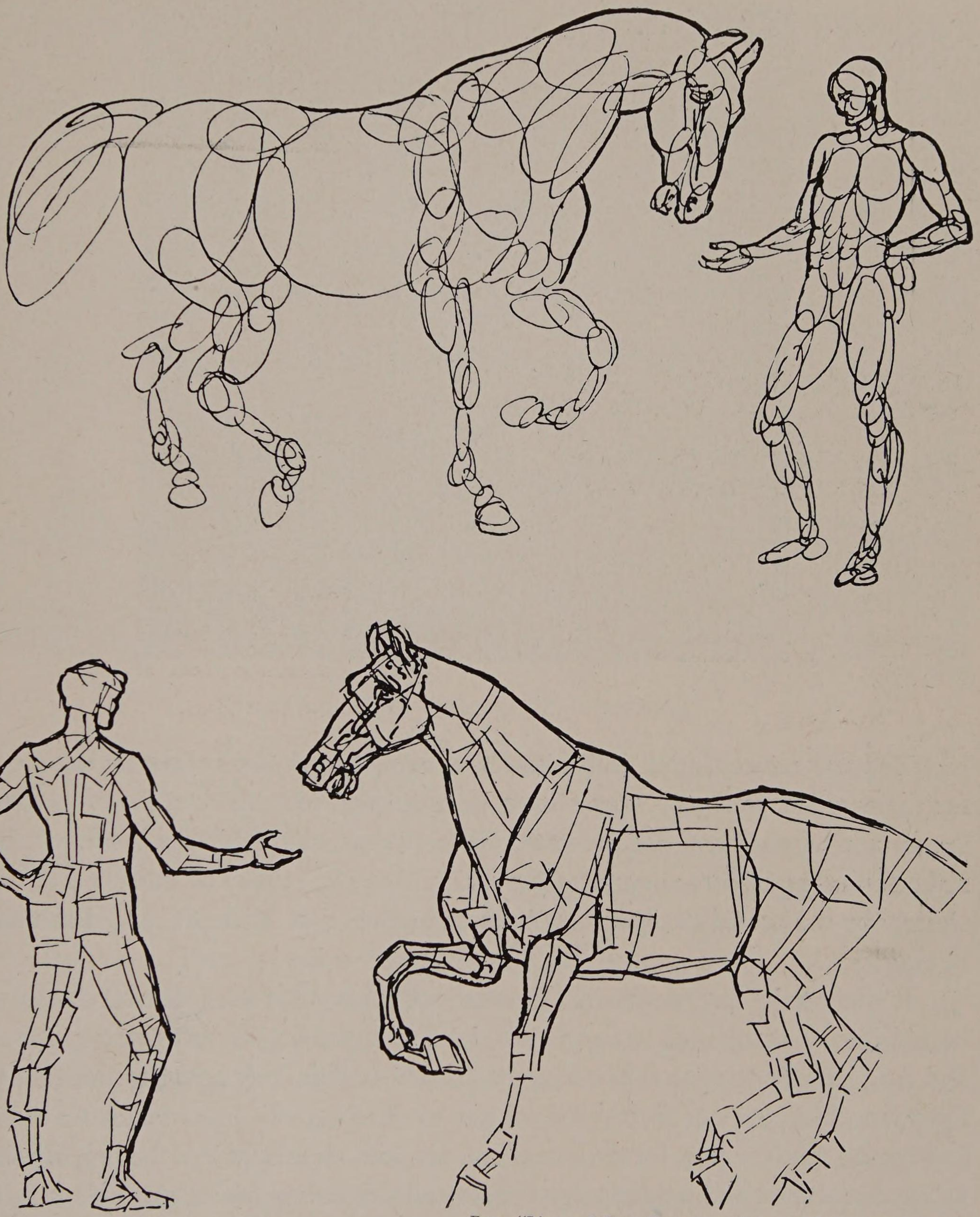
marked as to light and shade, so that you can get the same depth of modelling into your clay.

If your apple or pear has a stem, make this by rolling a small piece of clay on the palm of your left hand until it is the right length and thickness. How differently the stems of pear and apple grow! In the former, the stem seems hardly more than a continuation of the tapering upper end, while in the latter it grows abruptly out from a deep hollow.

Occasionally, as a change from modelling the fruit, sit down with paper and charcoal and try drawing; first a single object and later a group of two or three together. For drawing is an essential in all graphic and glyptic arts. Begin as you did when modelling by placing the fruit in such a light that plenty of shadow can be seen, for it will be solely by that light and shade that you may hope to give your flat drawing the third-dimensional roundness of the fruit itself. A white wall, cloth or piece of cardboard placed behind the fruit will make your still life stand out sharply and clearly. Outline the entire mass very lightly and sketchily at first. When you have thus placed the group on paper it will be time to correct your drawing with firmer strokes. After the outline is drawn with some degree of accuracy, study the fruit again with half-closed eyes. This will enable you to see only the large areas of light and shade; all distracting details will be shut from view. It may be wise then to indicate lightly on your drawing the dividing line between the light masses and the shadows, and boldly block in the important great shadow masses. You will be surprised and pleased to note how, when this is done, your fruit suddenly takes on "body," and stands out on your paper. Don't carry these practice sketches too far. Don't try to indicate the subtle distinctions between half tones, reflected light, or the color of the fruit itself. Such things are as yet beyond you, unless you have had previous experience in drawing. Your main object is just to set down, in graphic black and white, the forms you see before you.

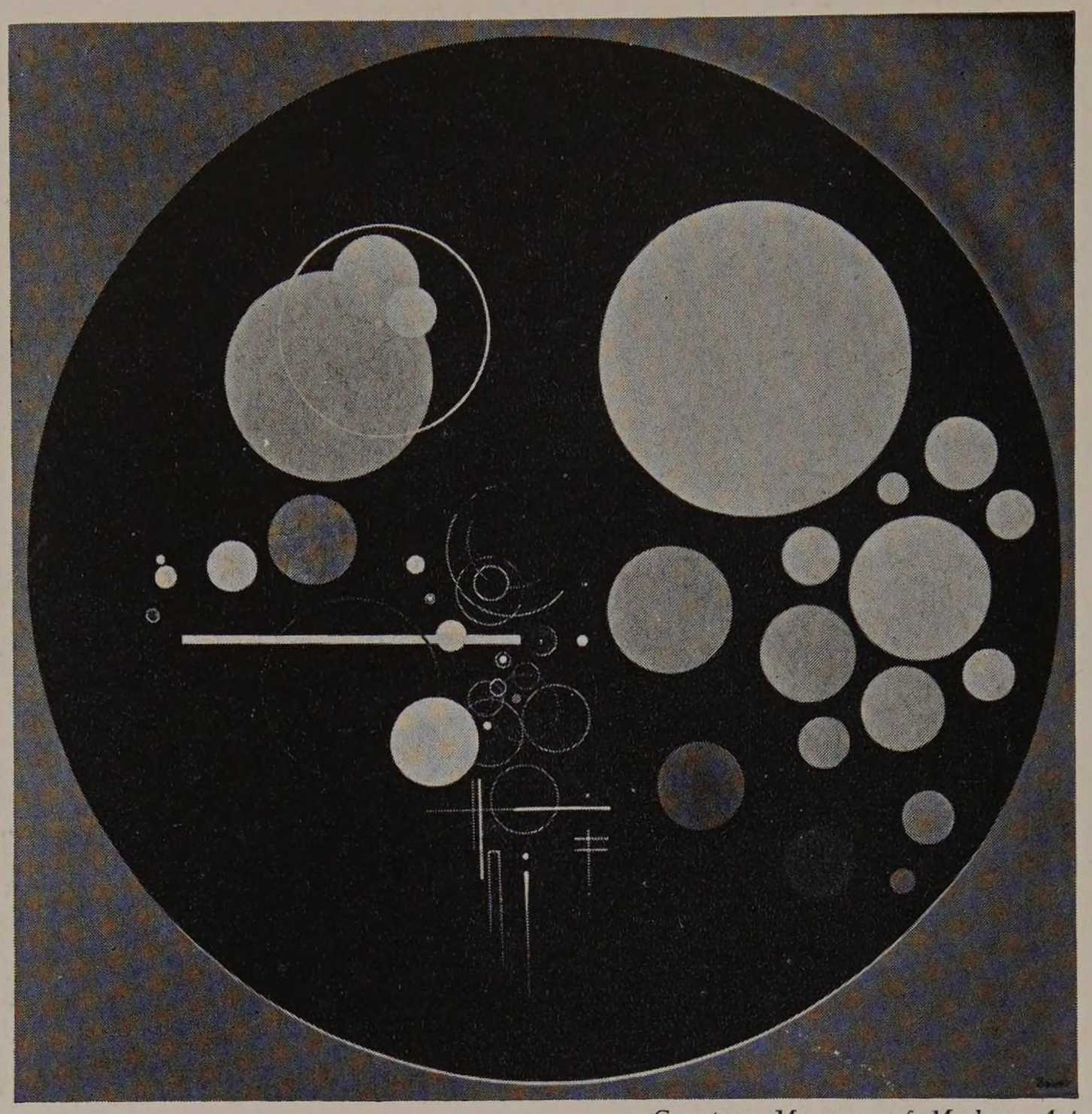
If you are taking up modelling merely as a hobby, thorough training in drawing is possibly not vitally essential, but anyone who intends to do serious work in art must certainly learn how to draw. Moreover, he must keep on drawing throughout his career. Two or three years of drawing under a master should be accepted as a natural part of a sculptor's training.

If both drawing and modelling are new experiences for you, you may find it easier and more satisfying to draw than to model. At any rate, having tried the drawing, you will come back to the modelling with an eye already better trained in observation.



From "Line and Form," *courtesy George Bell & Sons, London*

PLATE 5. Curved Lines and Straight. Walter Crane



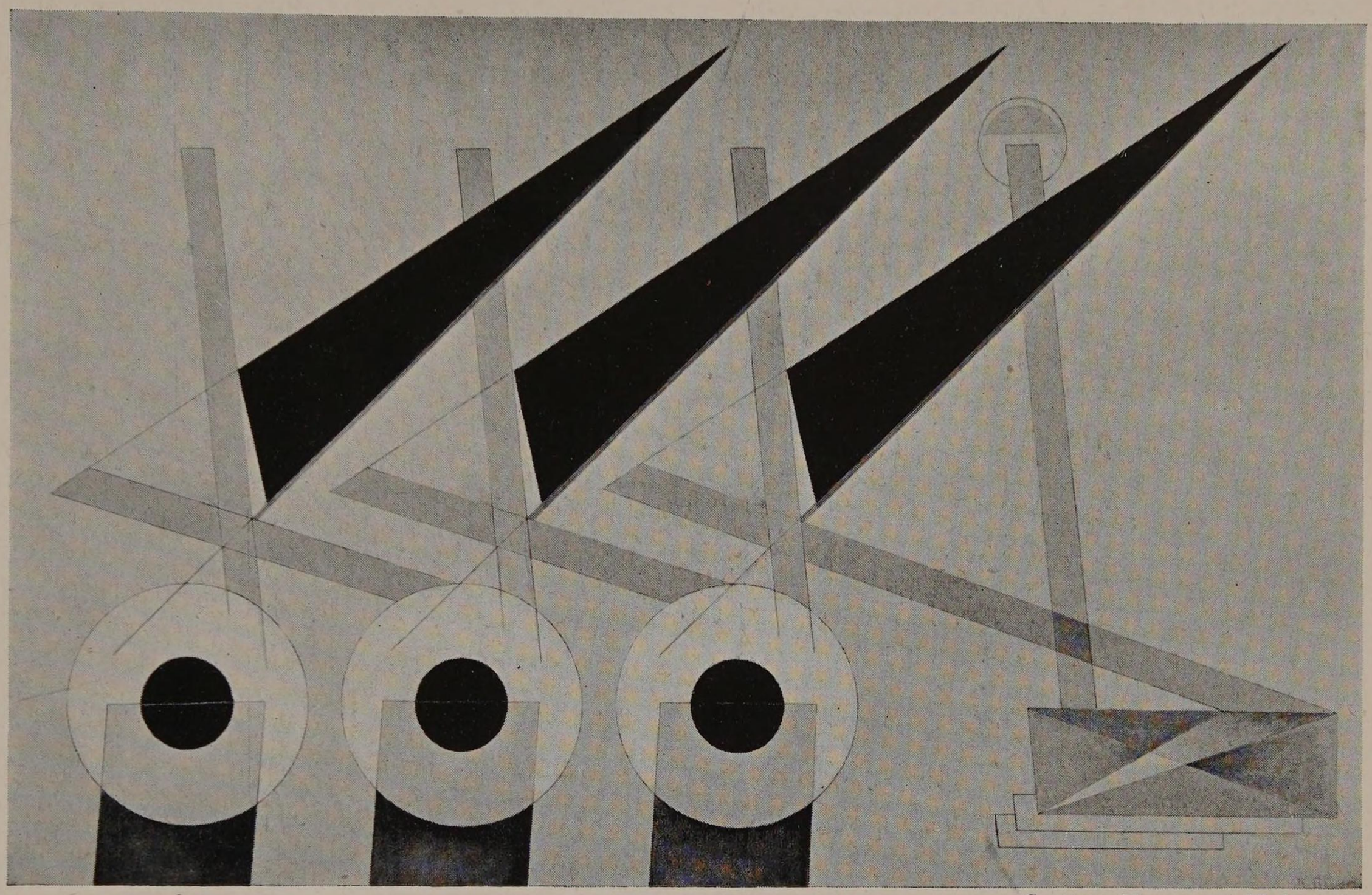
Courtesy Museum of Modern Art

PLATE 6. "Symphony." Rudolph Bauer

You will notice that all fruit forms have a number of *plane* or flat surfaces. Search for these and if your clay masses seem to be getting too round and soft in contour, it means that you have not indicated these planes with sufficient boldness. Planes make for strength, curved surfaces for charm. Any object may be modelled or drawn entirely by the use of straight lines or of curved ones, as Walter Crane demonstrates (Plate 5).

It was not by any means the "Cubists" who first discovered that all things could be indicated by means of straight lines, squares and triangles in painting; and cubes and flat planes in sculpture. The Mayans discovered that, long ages ago. And the great Egyptians, blocking out their noble effigies of the Pharaohs in huge chunks of stone, had far too much respect for their medium, too keen an insight into the proper relation between sculpture and architecture, to sweeten by rounding off the great plane surfaces of their carvings.

Everywhere in nature you will find such planes alternating and merging with curved surfaces: the ball and the cube in "close harmony." You will also find that it is



Courtesy Museum of Modern Art

PLATE 7. "Three Points." Rudolph Bauer

as impossible for man to conceive a shape not based on some combination of geometrical forms as it is for him to conceive of a tangible fourth dimension.

A few years ago I saw in Charleston, S. C., the Guggenheim collection of *Non-Objective Paintings.* What are these paintings? They are generally conceded to be the very last word in "modern" art. They transcend every "ism" and "arity" of the past fifty or sixty years. They are painted (and for the most part, supremely well painted) by such artists as Kandinsky, Fernand Leger, Rudolf Bauer, etc. And of what do these paintings consist? Of nothing whatever but primary geometrical forms, variously combined and grouped into compositions of curious and often dynamic intensity! (Plates 6 and 7). Though in a sense they are non-objective, in that they do not portray the literal and obvious world about us, it seems to me that they are fundamentally objective, in that they deal with the most actual, the most basic forms in all creation. They revert to the cosmic beginning of creation, completing the vast circle around which man the artist has been laboring for countless ages, and bringing him back on a great spiral to a point just above the one at which he started.

CHAPTER II

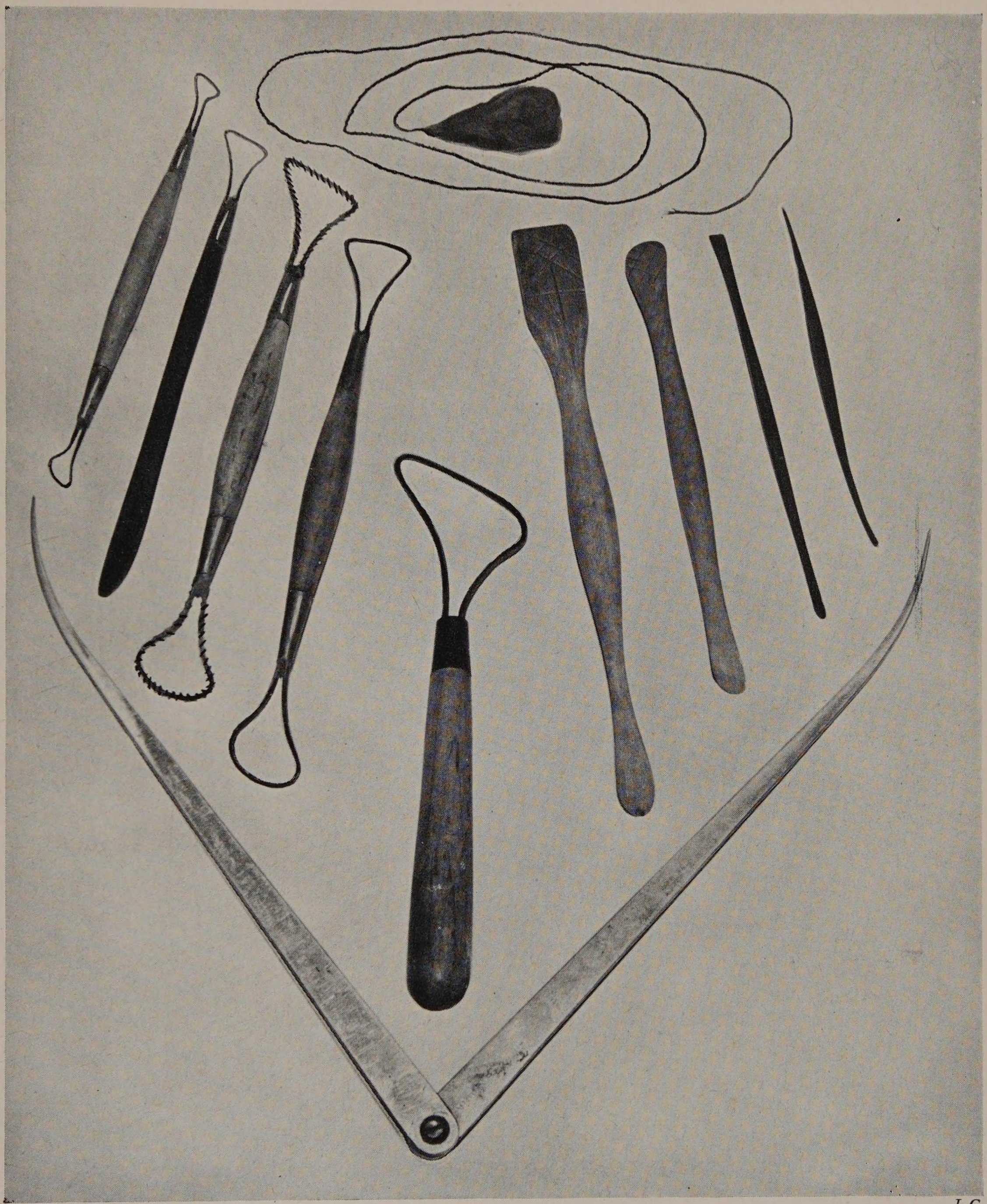
COPYING PLASTER CASTS

IF, after many experiments with fruit forms and combinations thereof, you find you still enjoy modelling, are stirred to creative effort by the very feel of the clay and have the courage to face the long upward climb through countless difficulties and failures; if you are convinced that this is the one and only medium in which you feel you can express what is in you, you must invest in some equipment: a few real modelling tools, a couple of stands and one or two good plaster casts to copy.

The ideal studio for a sculptor is a large, high-ceiled room, bare of all but the most necessary accessories. A skylight is very desirable but, failing that, a high wide window facing north will suffice. The window should have shades that draw up from the bottom, so that when they are halfway up the light falls at an angle down upon your work. A sink with running water is almost essential, not only to keep the clay constantly moist, but because modelling is always a messy job.

TOOLS

The tools illustrated in Plate 8 are fairly representative of those most generally used for work under life-size. All five tools ending in wire loops are for cutting away and for excavating hollows. The "sticks" on the right are used principally for putting on clay, for flattening planes, or for drawing outlines on a clay background, as in starting a bas-relief. The jointed metal object at the lower end of the picture is variously known as "compasses," "dividers," or "calipers," and is used solely for measuring. At the top of the picture we have a homemade plumb line—a gob of clay squeezed onto the end of a string. This line, suspended by its free end and weighted by the clay, gives one a true perpendicular, when held at arm's length between the eye and the model, and enables one to check on the *directions* of one's forms.



L.G.

PLATE 8. Modelling Tools

Most professional sculptors evolve their own special tools, which are made by an expert. Those bought at an art store are not usually as finely made as you would like, but they will suffice for the first few months of your training. After all, as old Hill the violinmaker once remarked: "A good fiddlemaker can make a violin with a knife and fork." And the great Italian sculptor, Andreotti, with whom the author had the privilege of studying, seldom vouchsafed his students anything more elaborate than a stick of kindling wood and a crude mallet for pounding up their masses of clay.

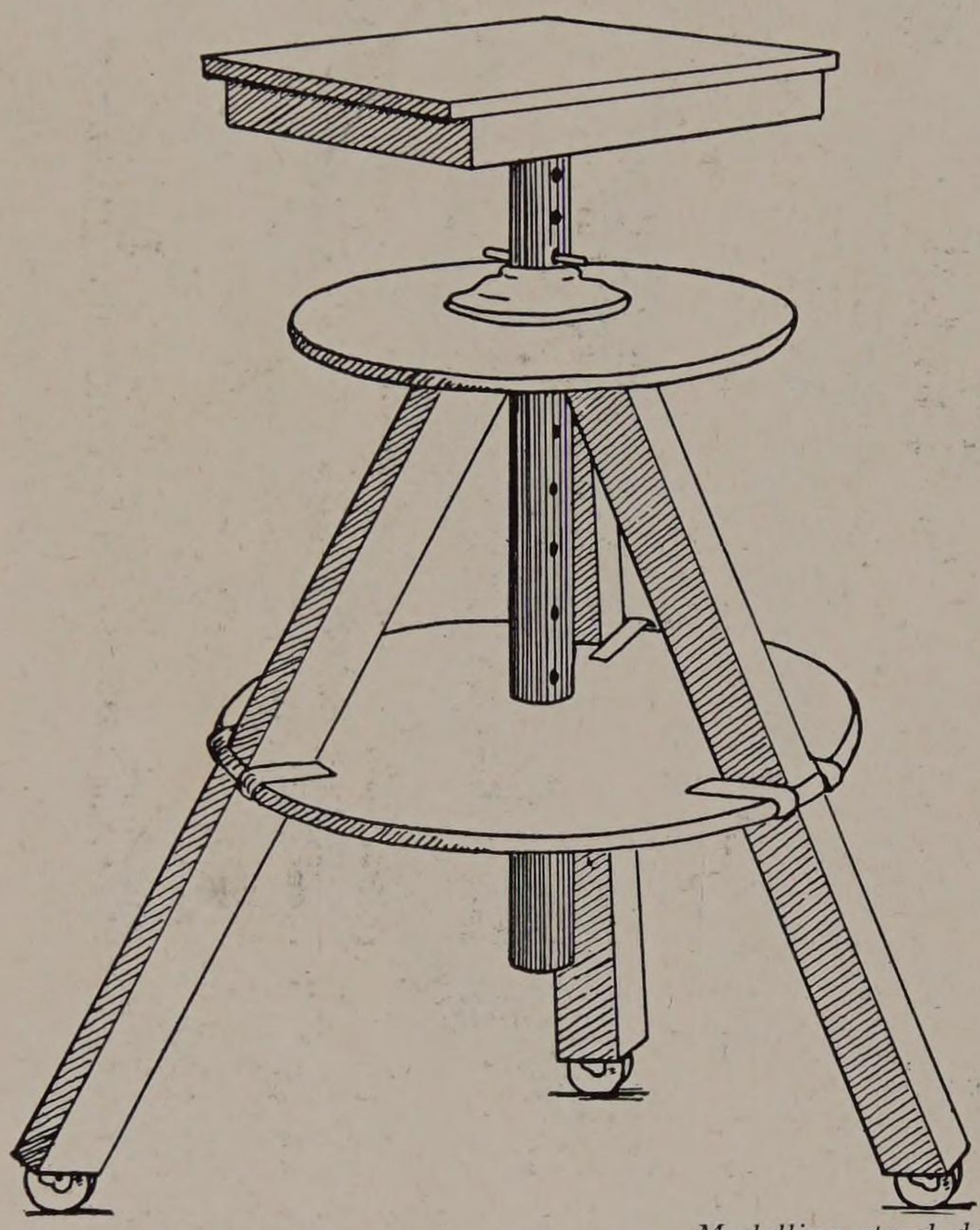
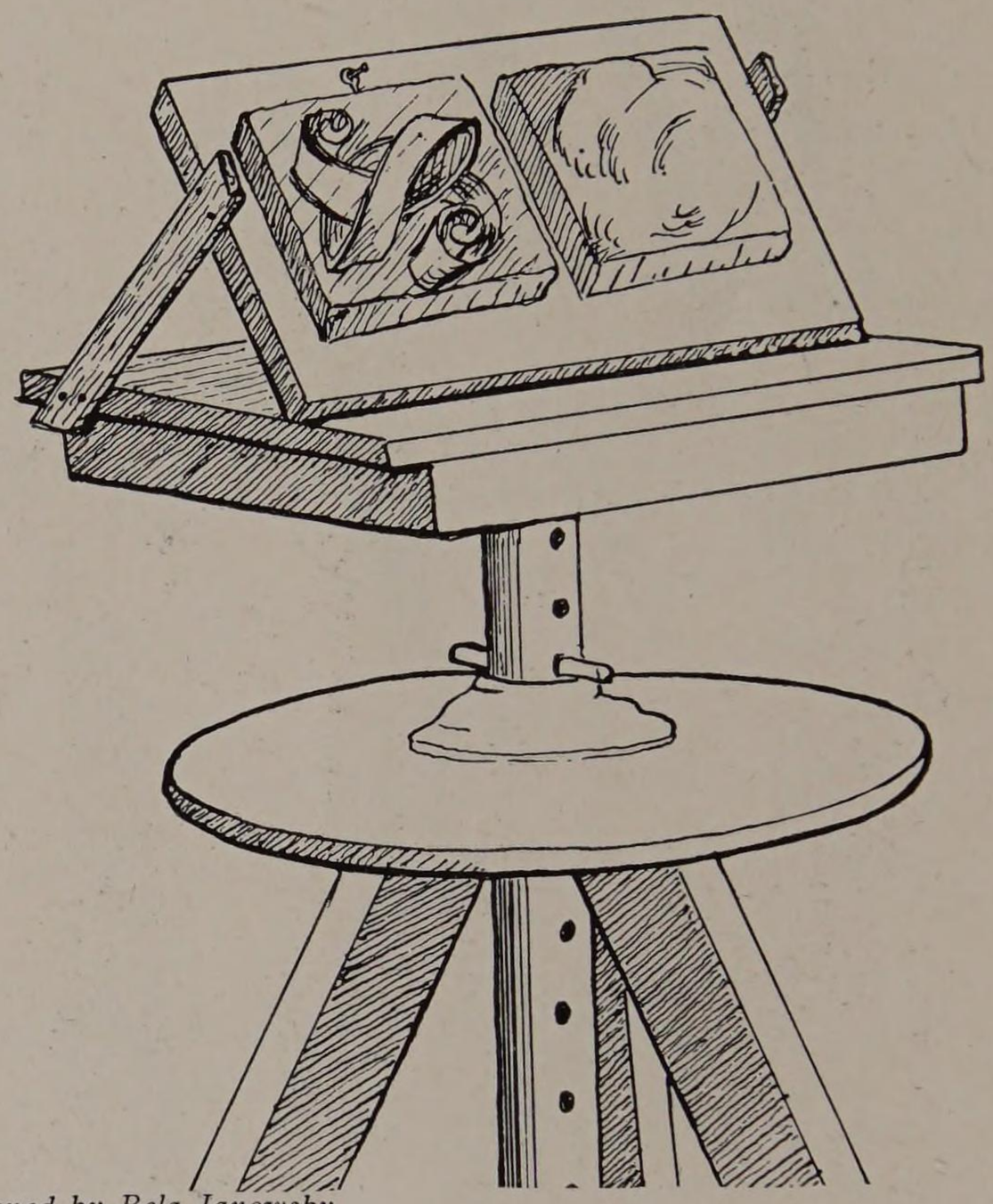


DIAGRAM 4



Modelling stand designed by Bela Janowsky

DIAGRAM 5

STANDS

Every sculptor requires at least two modelling stands—one on which to place his model, the other on which to build his own work. Such stands may be purchased at art stores. Diagrams 4 and 5 show in detail what I consider a good type. This particular stand was designed by a sculptor and has many advantages over most of those on the market. The wide spread of the three legs prevents the stand from toppling over, even if violently pushed, yet two or three such stands can be "nested" into a small space. The five-ply turntop will not warp and is adjustable as to height, as the central iron pipe can be raised or lowered at will and adjusted with a small pin. The two round shelves



Courtesy Caproni Galleries, Boston

PLATE 9. Animal Studies. Alice Decker

are handy to put clay, tools and cloths on, and the legs have special smooth-running casters, which make it easy to roll the stand about into different lights as you work. Moreover, this stand is put together with removable bolts, so that it may be taken apart and carried about like a couple of suitcases.

PLASTER CASTS

Too much copying from casts is bad for any artist, as it undoubtedly tends eventually to dull the creative faculties. But some careful copying is essential at this stage, for eye and hand must still be trained, in order that their clumsiness will not later on impede the flow of creative ideas.

"I know so well what I *want* to express," wails the untrained student whose ambition has outrun his technical ability. "I just can't make my hands and tools do what I want them to."

Let us forestall such difficulty by resolutely forcing those fingers and tools of ours to do what we want. Plaster casts are ideal for practice in using tools, in judging the size and direction of the various masses, in enhancing our appreciation of planes, etc., and they remain always the same, no matter how long it takes us to copy them. To plunge directly into "working from life," which so many students today yearn to do, is folly. "Life" is a vastly difficult problem, even for the mature artist. Moreover, life is never static; it can never hold still long enough for the beginner to master its construction, especially if he attempts to portray animals who refuse to pose properly.

The plaster animals in Plate 9 would be ideal subjects to use as models, but they may be hard to find in the ordinary art shops. However, among the many terra cotta animals sold in department stores you will surely find some that are modelled firmly and simply, like these.

Select one that has real mass and bulk, preferably in a seated or recumbent pose, not a standing one. Otherwise you won't be able to make the legs support the body. Such creatures as the donkey were modelled on a wire frame, supported by an iron bar. We call these frames *armatures,* and they are at present beyond your mechanical skill. But the other animals, being heaviest at the base, need no support. Look for some such compact, distinctive forms when you buy your first models.

Have you ever noticed that every one is based on some combination of geometrical forms? The kitten's head is a modified ball, its body a modified ovoid, its tail a curved cylinder, etc., while the frog, the calf and the brooding hen all suggest the pyramid.

Such studies should be modelled on a separate board, not right on top of your

new modelling stand. You may want to work on two or three at once and must be able to shift them about without damage to the clay. Use a stout board, 12 x 15 inches, or thereabouts. If you are modelling in wet clay, you should nail a couple of cleats, or thin strips of wood, about two inches from either end of the board, to prevent warping and to make the boards easier to pick up and move about. (See Diagram 71, Chapter IX.)

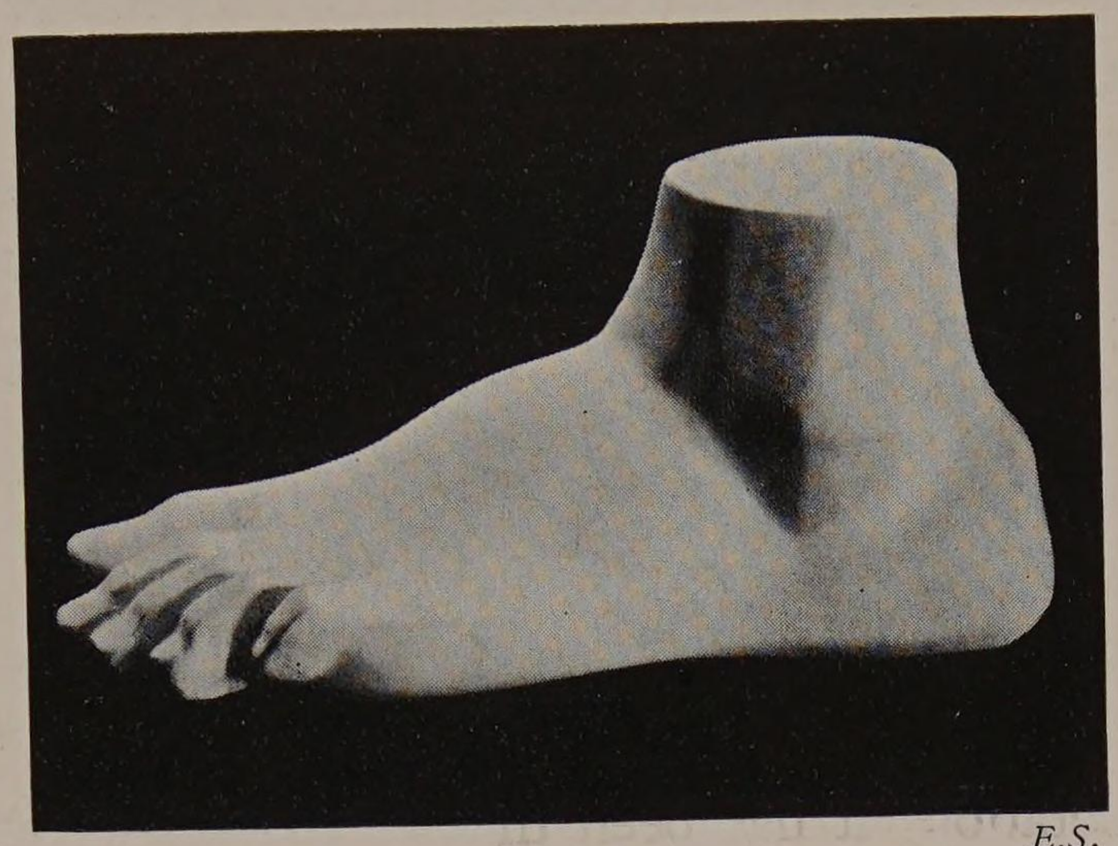
As these animals are mostly so rounded in form that you are in danger of forgetting about *planes,* the "block" foot (Plate 10) will be a good thing to try next, as it is made up almost entirely of flat planes (as is the human foot itself).

Up to this point, all your modelling has been "in the round," but if you elect to try next the scroll (Plate 11), or the eye or the mouth (Plates 12, 13), you will be modelling in "high relief."

For relief work we sculptors require something akin to a painter's easel, for we must look our work in the face, not keep bending over it. So we take two boards, one for each stand, and set them up on edge on our stands, not exactly vertically, but tipped backward at an angle, as in Diagram 5. Fasten these firmly by nailing two strips of board from each upper corner to your stand. Hang the plaster cast on one board and do your work on the other; or, if the cast is quite small you may put both on the same board, but not too close together. A few nails driven into the board before you pack on the clay will keep it from slipping off.

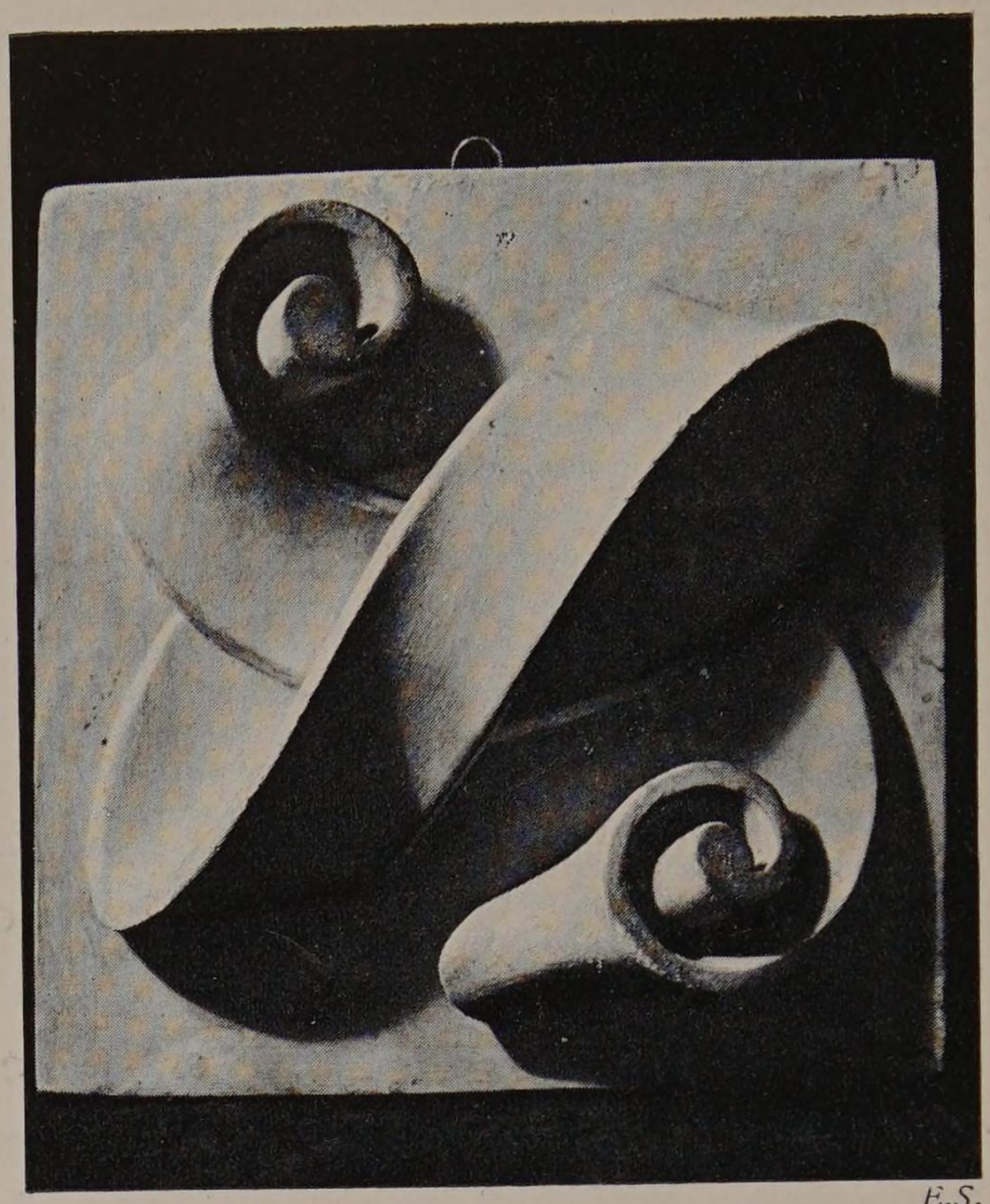
In copying the scroll, or any similar design which has a panel background, you must first model this panel quite carefully, pressing small pieces of clay very firmly onto the board so that they will adhere. Make your panel exactly the same size as your plaster model, or it will be difficult to get the proportions of the scroll itself correct (Diagram 5). Once the background is laid in, fairly level (but *not* "slicked"), take a tool and sketch in the general outline of your design. If your panel is the right size, it will be easy to check on the proportions of the scroll by measuring in from the border of the panel, as well as by measuring the design itself, with the compasses shown in Plate 8. Use these sparingly, however, lest your eye become lazy and too dependent on mechanical measurement.

Before you begin the actual modelling, and many times later on as you build up your forms, study the cast from the *side,* for only thus will you appreciate the full projection of the various masses. We are always inclined, at first, to make our forms too meager and flat. Model in a good strong light that will accentuate the richness of



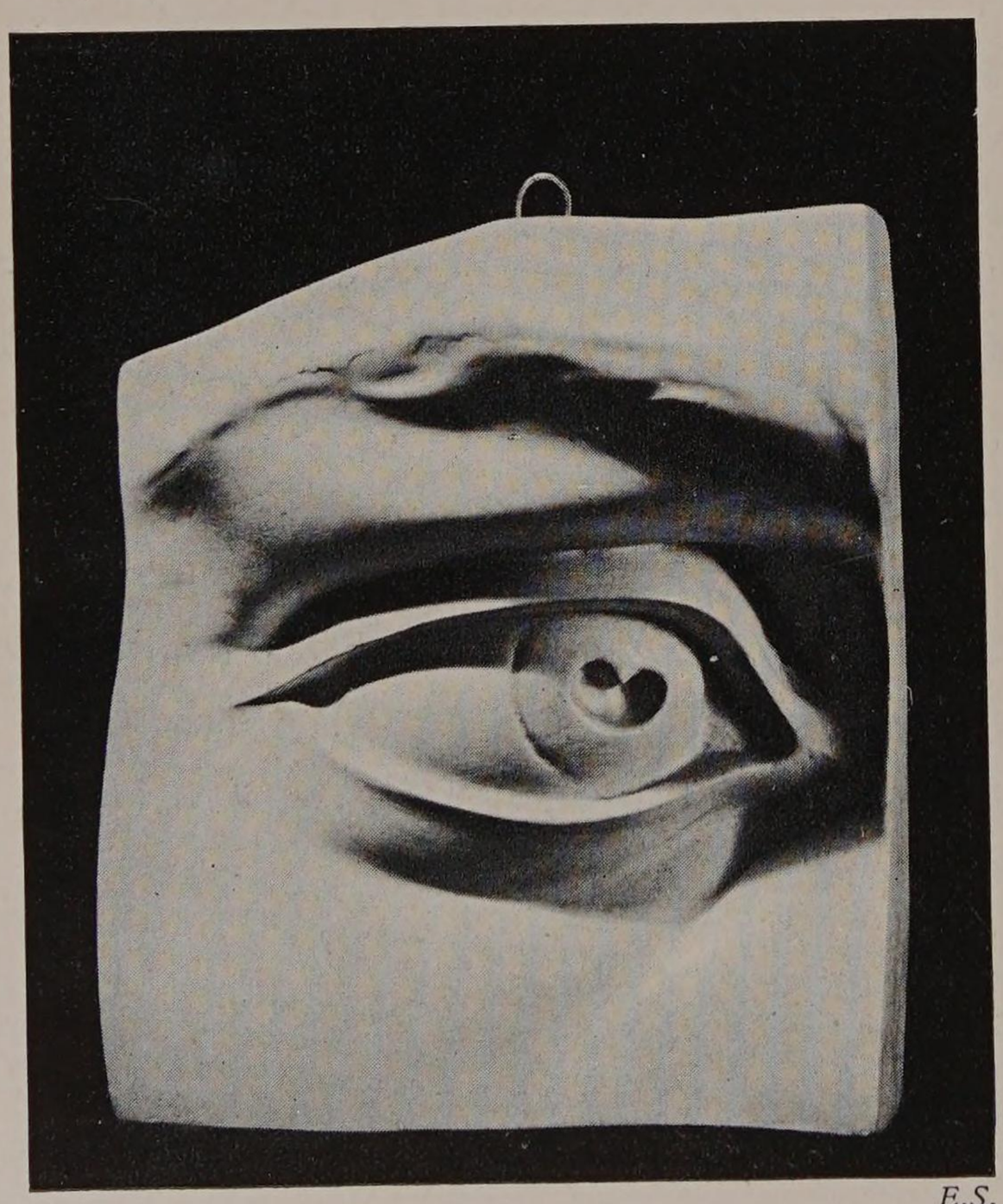
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PLATE 10. Foot



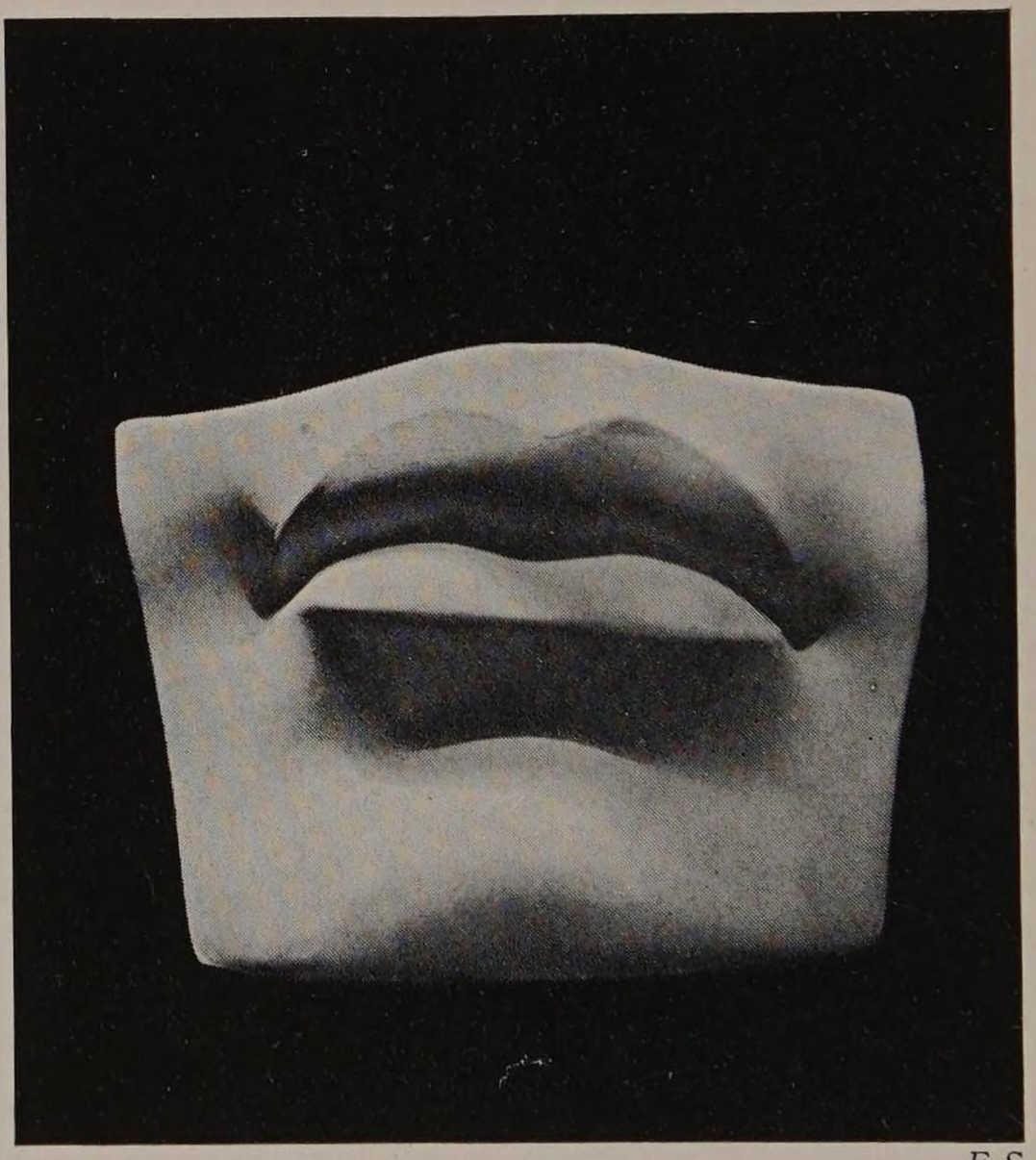
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PLATE 11. Scroll



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PLATE 12. Eye



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PLATE 13. Mouth

the modelling. And do not forget to *change* this light frequently as you work, having it fall first from one side and then from the other, by moving your stand. This practice of shifting about cannot be begun too early and it should become an unconscious habit, for if we model in one light only, we neglect those forms which are either in shadow or in bright, flat light.

Another excellent habit to acquire early is that of *walking away* from your work every little while and viewing it with a critical eye from the other side of the room. All the unessential details over which you have been laboring so meticulously will count for nothing at a distance, while if the main masses or directions of your modelling be wrong, these faults will stick out like the proverbial sore thumb.

The mouth of Michelangelo's "David" (Plate 13) is probably the most superbly modelled mouth in all sculpture. For generations it has been the standard for the student of sculpture. The richness of the modelling brings home to us forcibly the essential pattern forms to be found in all mouths. Note how the upper lip is composed of three distinct masses: one on either side springing up to meet the smaller central form, which is like the keystone of an arch. The lower lip, on the other hand, has but two masses, with the keystone of the upper lip fitting between them. Few people realize the depth of the corners of the mouth, because they fail to understand that the lips are built over the horseshoe curve of the teeth, not over a flat plane. Dig boldly into these richly modelled corners, for they are vitally important, as is also the deep valley between lower lip and chin. Once your main forms are laid in, it would be well to draw a vertical line straight down through the center of mouth and chin. Only with such a guide can you hope to make the two sides symmetrical. You will notice that the "line" between upper and lower lips is neither thin nor straight. In fact, there is no such line at all: the forms do not actually meet, but seem rather to spring *away* from one another. And what a firm ridge the sculptor has made around the edges of the lips, showing the line of demarcation between the "red" part and the thicker skin of the face itself! Study your own mouth in a mirror, noting how it resembles, how it deviates from, the sculptured mouth.

The cast of David's eye (Plate 12) is quite a difficult thing to copy, but well repays searching analysis, for it, too, is the perfect standard of the human eye, and these exercises with casts are meant to prepare us for the study of human beings. I can think of no better foundation for portrait sculpture, as the two least understood features are the mouth and the eye, which the tyro invariably makes too flat and scratchy. He places

the eye on the *surface* of the face he is modelling, instead of making it thrust roundly out from the depths of its *socket.* Michelangelo makes us realize that the eye itself is a *ball,* forcing the lids apart and modifying their shape by its various movements. As the cornea is slightly more prominent than the rest of the eye ("like a watch crystal laid on a golf ball," as someone once described it) it tends to push the upper lid out, and this highest curve of the lid always corresponds to the cornea, or the direction in which the eye is looking. David's eye is turned somewhat toward the nose, so that the upper lid arches near the inner corner. Not so with the lower lid, however, where the deepest part of the curve is nearer the outer corner. This gives a *diagonal direction* to the whole eye which must not be overlooked. Notice, also, the difference in shape between the outer and inner corners. At the outer, the upper lid overlaps the lower at an acute angle, while at the inner, the two lids meet in a rounder and more obtuse angle, allowing space for the tear duct.

Should you decide to get this cast to work from, let me advise you to adjust it properly before you begin. This cast is but a section taken from a head carved in the round. As it lies on your stand you will note that the inner corner of the eye is much deeper and nearer the board than the outer. As this never happens in nature and as the sculptor most certainly never intended it, you should remedy the trouble by inserting a wedge under the right-hand edge of the cast, forcing it up until the inner corner of the eye is slightly nearer to you than the outer, and as it would be if you were looking directly at the face. I advise this because more than one student, who has come to me after having made studies of these casts elsewhere, has acquired the unfortunate notion that all eyes are deeper in the inner than in the outer corners, and it has taken months to overcome this early mistake. More about eyes will be found in the chapter on the portrait bust.

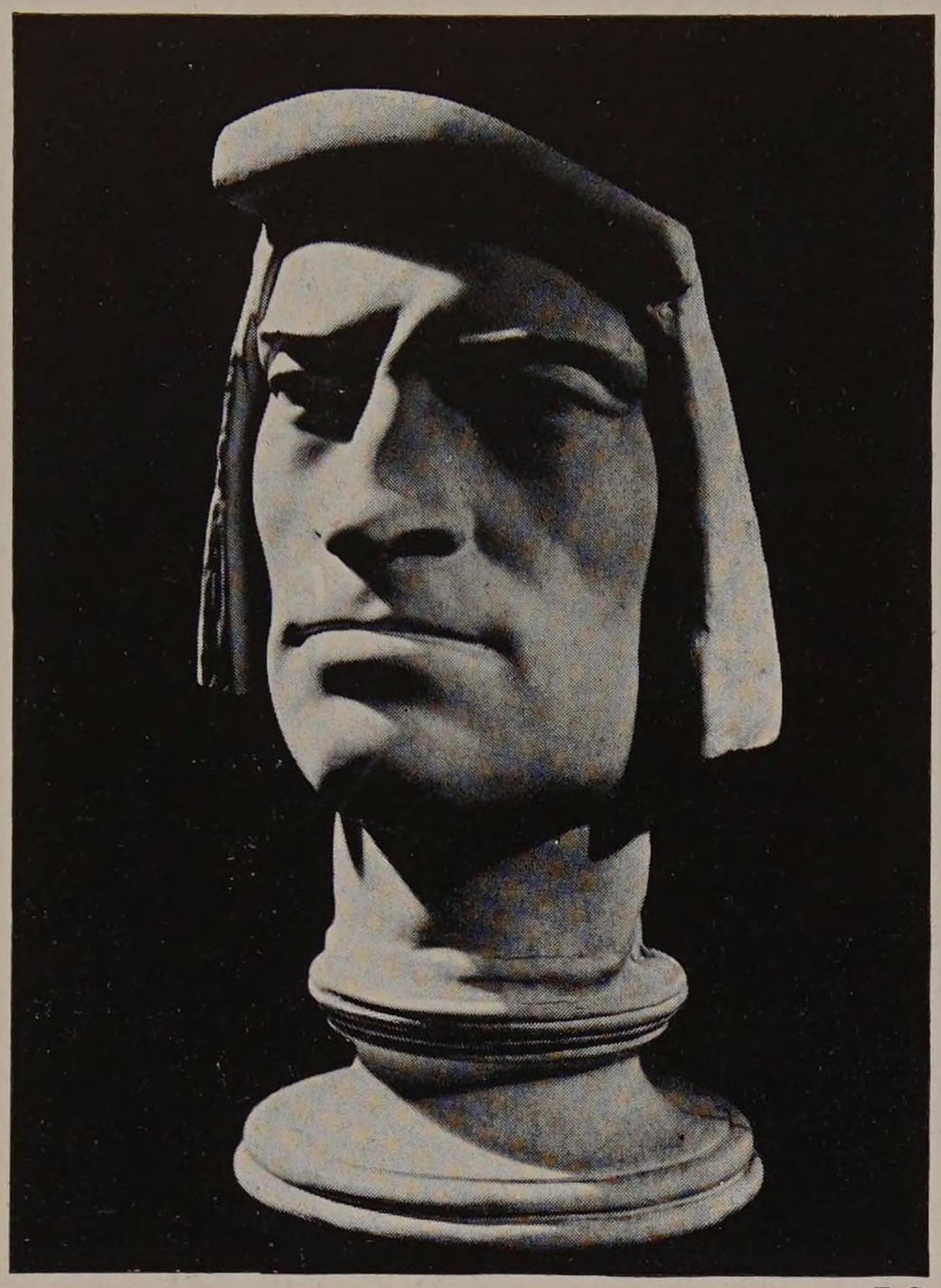
By now I am sure you are impatient to try your hand at some casts of the whole head. If so, be sure to begin with a strong masculine head which has plenty of character and bony construction in it, such as the Roman portrait in Plate 115. Do not choose a pretty, soft, feminine head, for this will teach you nothing about the essential framework of the head and face. The cast in Plate 14 is but a mask, not an entire head, but the bold and clear-cut features make it an excellent subject for study. Who was the sculptor? I think you may be interested to know. This cast, reproduced by all the large plaster statuary firms in the country, is in their catalogues attributed to Michelangelo. This puzzled me, for I happen to own photographs of every known work by this master

and this head is not among them. Furthermore, it has in it none of the characteristics of the great Florentine's work. So, not satisfied that it was indeed a Michelangelo, I took this photograph to an authority at the Metropolitan Museum of Art. Dr. Weinberger then told me an interesting thing: "This mask was not modelled by Michelangelo, nor Donatello, nor by any Renaissance sculptor, though it is a likeness of Lorenzo de' Medici, known as 'The Magnificent.' It is a death mask of this famous prince, made by some probably obscure, and certainly unknown, sculptor, who later added the locks of hair and bit of cap to give it a lifelike look." In my long search for a strong and vital head for you to copy, I passed up many a portrait by distinguished sculptors, selecting as finest of all one that may be said to have been modelled by God Himself.

A very few of the classic heads of the earlier Greek art make good material for study, but most of them are such feeble copies (having lost most of their modelling under the diligent sandpapering of the caster's apprentice), that they are hardly worth buying. It would really be better to get a vivid head like that of Verrochio's whimsical young "David," (Plate 15), with his girlish curls and roguish smile; for no amount of careless casting can spoil the vigorous thrust of the shoulder and turn of the neck which make this bust so alive. Let me warn you, however, not to get lost in his maze of curls. Indicate them for the present simply as a mass, a sort of cap (Plate 16). If you can find and truthfully render the several great planes of chest, cheeks, etc., and place them in proper relation to one another, you will have achieved quite enough for the present. After that, you may have your "dessert" by copying one of Desiderio da Settignano's exquisite baby heads (Plate 17).

For modelling heads in the round you will need some sort of framework, or armature, to hold up your clay, as the neck is too small to bear the weight of the head. On page 216, two types of head-armatures are illustrated, but all you need at present, for a comparatively "perpendicular" head, is a stick, between one and two inches thick, fastened upright in the center of your board. This may either be nailed down, or fastened with screws and angle irons. If you squeeze the clay very compactly around this stick, using quite hard clay for the first layer or two, you should have no further trouble with the sagging of the clay.

It is not to be expected that at this stage of your career you will be able to make a true copy of anything as difficult as a portrait bust. But what you *can* try for is a sound construction of the principal masses—head, neck and shoulders, all of which are founded on geometrical units



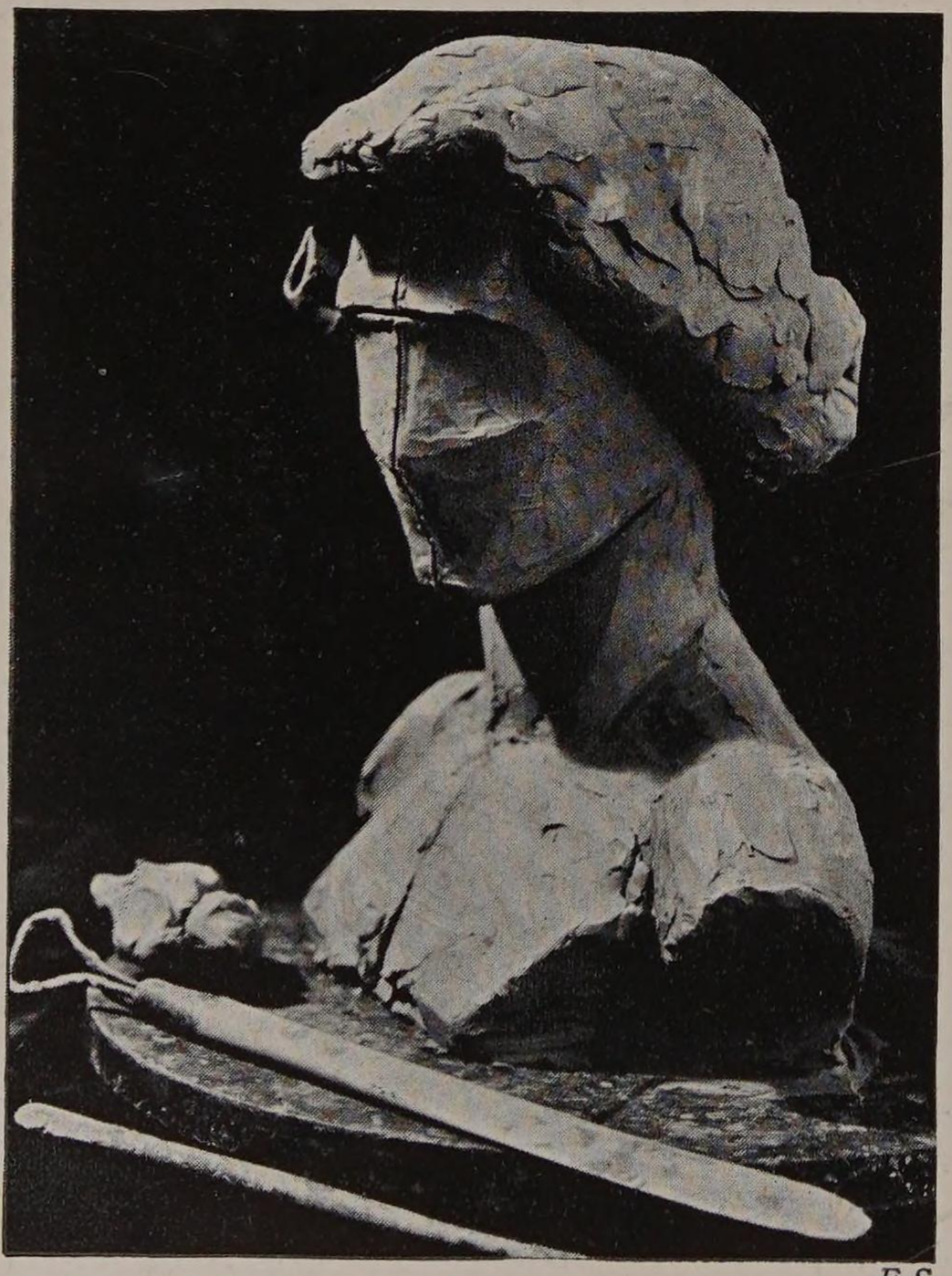
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PLATE 14. Lorenzo de' Medici, *Mask*



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PLATE 15. Head of "David."
Verrocchio



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PLATE 16. Clay Study of "David"



E.S.

PLATE 17. Head of Child. da Settignano

Every solid form, be it sphere, cube, or ovoid, has a central axis, just as the world itself has its axis. The head, being but a variant on these forms, is built around just such a central line, or pivot, and this essential line, invisible though it be, must be established at the very start. If the head you are copying is thrown ever so slightly off the rigid perpendicular (as most heads are), either forward, back, or sideways, the axis must also deviate from the perpendicular. Some of my pupils have found that a good way to test this is to take a rubber ball and drive a nail straight through the center. Use a nail, or axis, long enough to project through both "poles." Holding this up beside the cast you are about to copy, tip and turn the ball this way and that until you are sure that its axis lies in exactly the same direction as that of the plaster head. Memorize this direction, both from the front and from the side, and never let it slip from your mind again. As soon as you have enough clay on your armature to approximate the mass of the plaster head, establish the axis on the surface by drawing a corresponding line straight down along the center of the face. Carry this line clear over the top of the head to the back of the neck, being careful to draw a truly straight line. Now from the side, draw a line up one side of the head and down the other, so that it will intersect the first line at the top of the head at right angles. Once these lines are accurately laid in and the point on the top of the head where the lines cross established by a nail or a match stuck into the clay, you may rest assured that your foundation is correct. Now you must "true-up" the right and left halves of your head, working out from your median, or axial, line, for the two sides of a head are symmetrical, though front and back are very dissimilar.

In the Verrocchio bust (Plate 15), you will notice at once that the axes of shoulders and head lie at entirely different angles. This is due to the flexible neck, which twists as it forms the connecting link between the body "box" and the head "box."

To check on the various proportions of your work, compasses, or calipers, are necessary, for the eye alone is not yet to be trusted. With a pencil, mark a central point on the cast, right down by the board it rests on, then mark a corresponding point on the board at the base of your clay head. With one end of the calipers on this point, measure up to the top of the head, the pit of the neck, the point of the chin, etc.; also measure the length and width of the head, and its greatest length from top-back of head to chin. A measurement from the base or from the pit of the neck to the top of the nose will give you the point at which you may indicate the line of the brows, which will always be at right angles to the central axis. Not until such "construction work" is done should you

allow yourself the pleasure of modelling the face itself. If you begin "playing" with the various features and trying to get the "expression" before doing this, you will most certainly flounder.

A final word about the use of pencil and paper, before we go on to the next chapter. If you are to be a sculptor, you *must* be able to draw—if not with professional mastery, at least with enough assurance to jot down with some degree of accuracy the things you see and the ideas you wish to convey about them. For nature is, in many of her manifestations, far too fleeting to be labored over in the slow process of modelling or carving. She must be caught on the fly, as it were, and the sculptor should always be armed with a pencil and paper, ready to make rapid notes of what he observes about him. Even the crudest sketch of the turn of a child's head, the fetlocks of a horse, the characteristic folds of a laborer's trousers, will all be of specific use at some future time and will be of inestimable value in training the eye to note significant forms in nature. And for making preliminary sketches of work that you expect to carry out later in clay, drawing is an absolute necessity. If you happen to live in a small community where, though there is no modelling class, there is a drawing or sketch class, by all means join it. The time you give to drawing will never be wasted, for even if your drawings may not amount to much, your eye will gradually become that most priceless item of an artist's equipment, a "recording camera," which will seize upon and remember all sorts of valuable material. For it is upon this *cumulative* memory, reinforced by imagination, that you will most frequently draw when you have reached the point of true creation. The finest art is not based upon a single observation or experience, but upon fundamental truths which, seen over and over again, have so beaten in upon the artist's consciousness that he is finally convinced of their universal significance.

CHAPTER III

GROUP COMPOSITION

WHEN a sculptor speaks of composition, he refers to the massing together, into a coherent whole, of two or more individual forms or figures. Such groups are usually built around a central axis, and the most permanently satisfying are those whose total mass is based upon some geometrical figure. Believe it or not, the finest paintings and sculpture of every art period have this fundamental plan underlying their composition. You will find it if you look, even though the work of art seemed to appeal to you for quite other reasons.

To some artists this ability to amalgamate several different units into a single, well-proportioned whole is entirely instinctive. To others, it comes hard and must be striven for. You may have heard or read something about "Dynamic Symmetry." Jay Hambidge, one of the most earnest and convincing proponents of this theory, claims that the finest art, especially the Greek, was worked out according to the strictest mathematical formulae; he holds and takes great pains to prove that the curved body of a Greek vase, for instance, is in true mathematical proportion to every other part; that the handle and spout, too, are based on an established ratio. Nothing is left to chance—the potter must be versed in algebra and geometry if his pot is to have satisfactory proportions. Hambidge is convinced that these laws obtain not only in ceramics and architecture, but also in sculptural representations of the human figure and in fine paintings of all periods.

Pursuit of this theory would lead us deep into the realm of higher mathematics, which is not the realm of this book. The scientific student will certainly be much interested in reading Mr. Hambidge's works, but for others it will, I think, be sufficient to revert once more to those geometric forms referred to in Chapter I and see how they may be applied to the laws of composition.

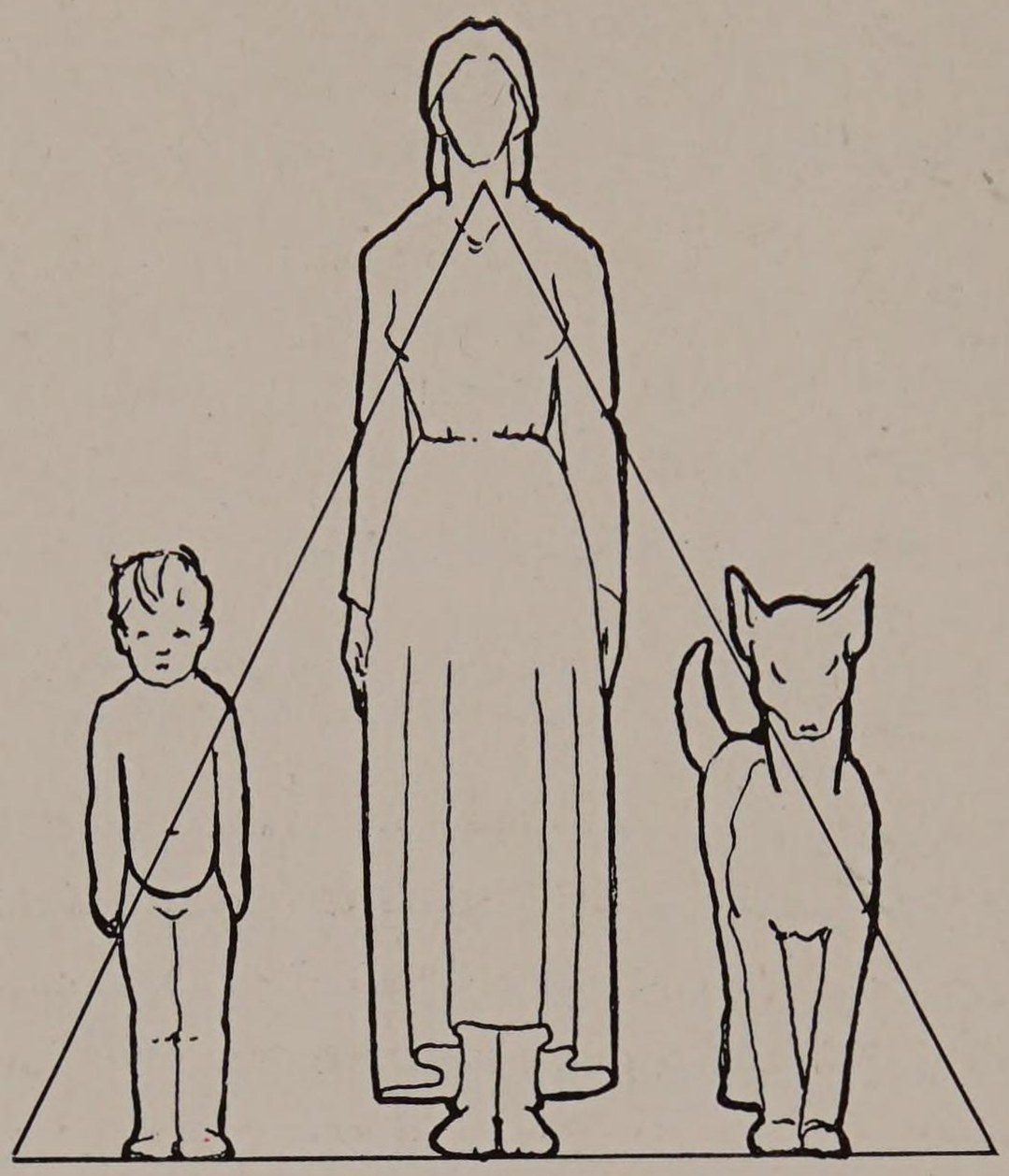


Diagram 6

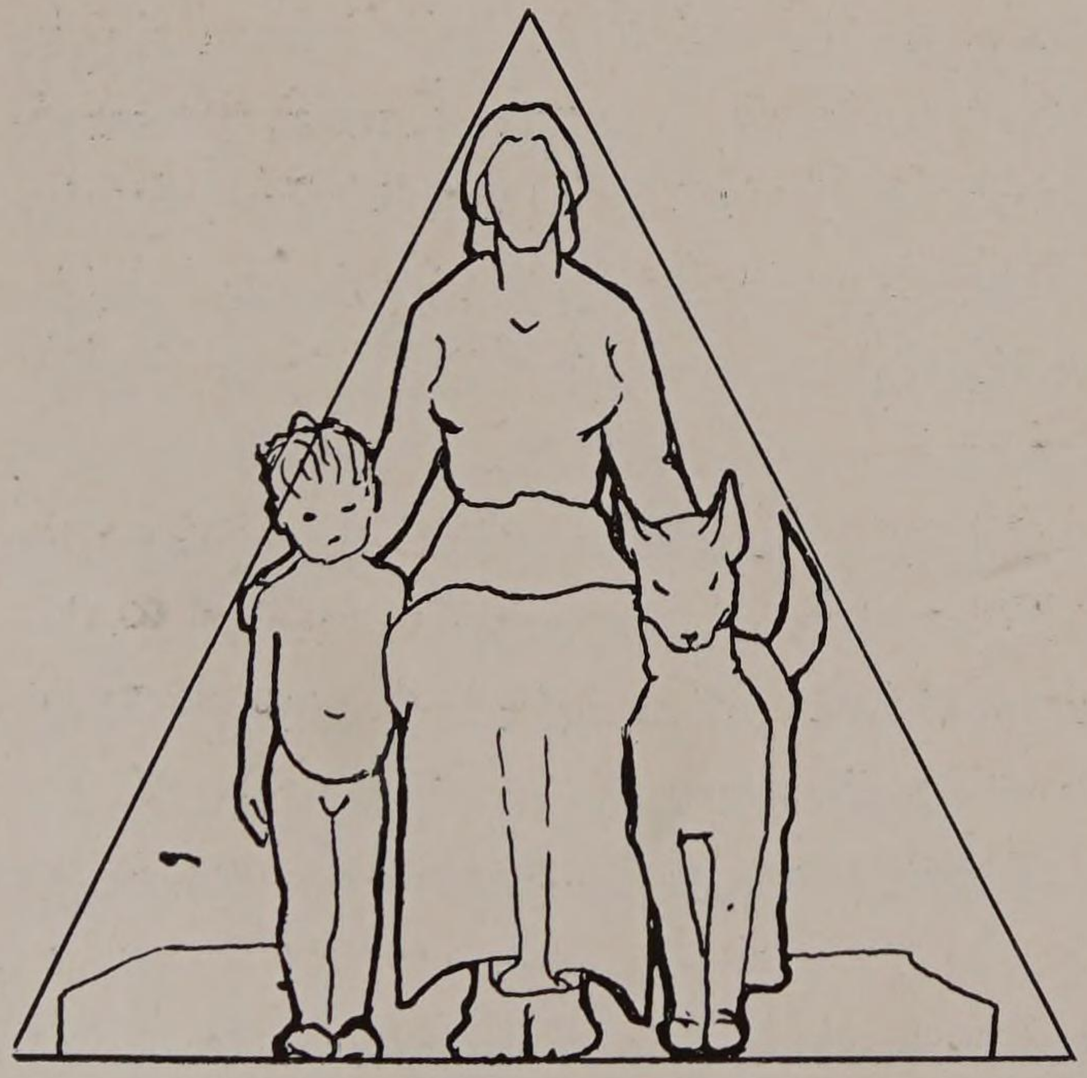


Diagram 7



Diagram 8

PYRAMID AND SPIRAL

Let us suppose, for example, that you have had your fill of copying and want to make up something of your own. You may be moved to create a group of little figures—like a woman, a child and a dog. Don't let this first creating be simply a haphazard sticking of three figures together. From a purely practical standpoint, as well as an aesthetic one, you will come to grief if you just "let the thing grow." Legs will collapse and arms will fall off, and you will waste time and patience trying to prop them up with sticks and hairpins. *Created* work must be thought out in advance, even though minor changes and improvements may be suggested to you, as you work, by the very clay itself. Let's see if you can *think* this group within the boundaries of, say, a *pyramid.*

With pencil and paper, we indicate roughly the pyramid, and naturally we draw the woman in the center with child on one side and dog on the other (Diagram 6).

Now this is hardly a pyramid. So far it has been conceived only in *plane* geometry. It is a triangle, but not yet a three-dimensional pyramid; all the interest lies on one front plane and the woman does not fit into the design. Well, suppose we make the woman seated; both the seat and the horizontal direction of her thighs will help to "carry through" from front to back, as will the body of the dog. It will also help to bring her head down within the pyramidal outline. So far, so good. But neither child nor dog conforms, as yet, to the slanting sides of the pyramid. To bring them into the composition, we shall have to move them in toward the woman (Diagram 7). Nature herself will help here, because she makes her creatures more or less flexible, so that they can be bent or twisted into various positions.

With this further idea of twisting, we may consider a new element which will most certainly be of service in bringing our work to life and in carrying around to the other three sides of the pyramid, namely, the *spiral.* Curved lines may be said to be living lines and, of these, the spiral is the most living of all, for it moves, it either grows or diminishes, it *goes somewhere!* It is one of the primary lines of growth and unfolding in nature. Did you ever examine the whorls of a snail shell? Did you ever have the opportunity of seeing in stop-motion films a tendril reaching out to gain support for an upward climb, or a morning-glory unfolding in the early sunlight?

Now, if we think of a spiral line or direction starting at the neglected rear of the pyramid, where will it lead us? If we make the dog sit down on his haunches and curl his tail around toward the back of the composition, we immediately have a satisfactory

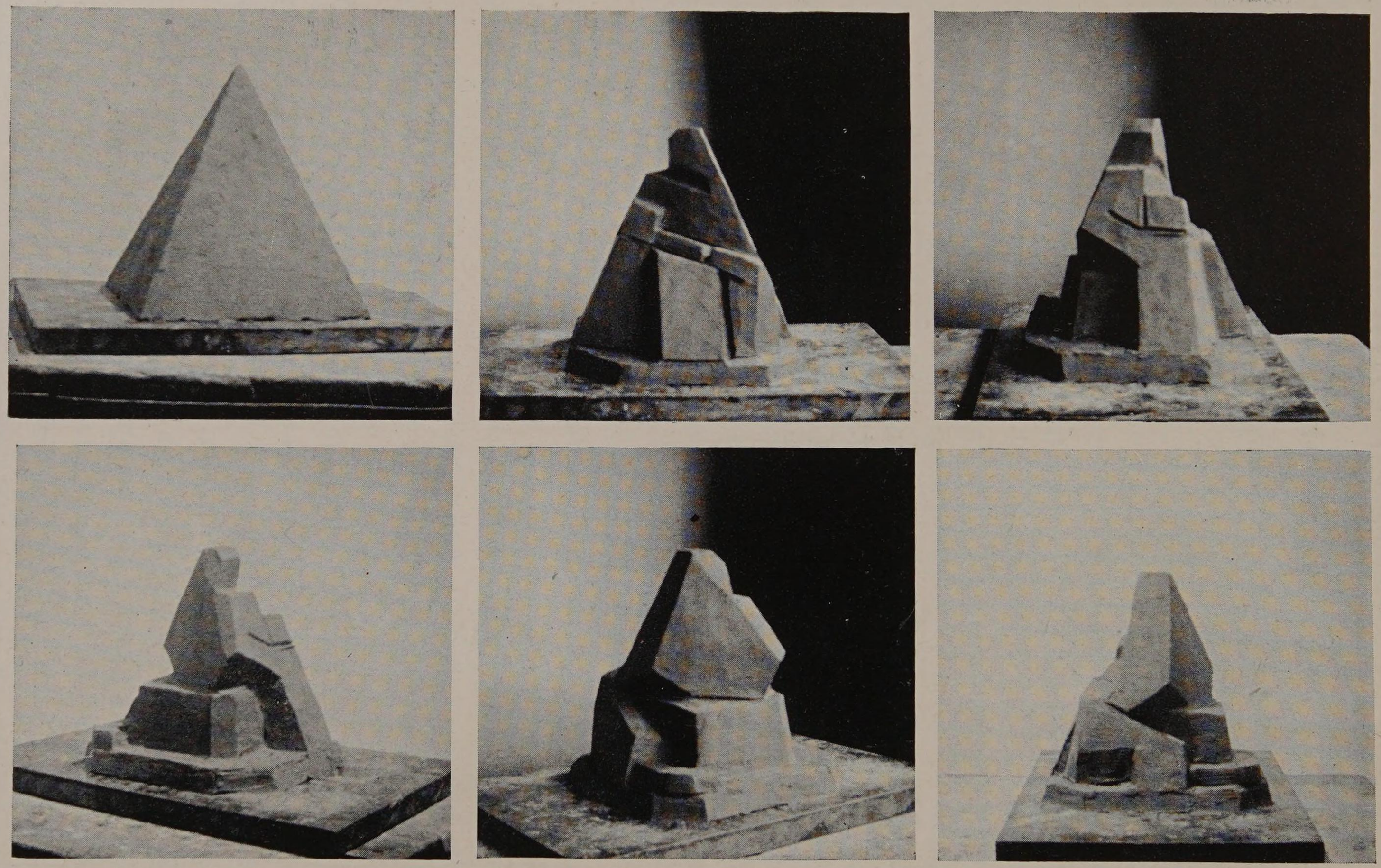


PLATE 18. Pyramidal Composition

"ramp," up which our spiral can climb around the side toward the front of the group. If we lay his nose on his mistress's lap, it will follow exactly the upward twist of the spiral. And why can't the child's arm stretch across to stroke the dog's nose? This will give an interesting diagonal line across the face of our pyramid, and the spiral can logically pass upward and backward through the woman's right arm and, ever-diminishing, curve around her head, which will be bent toward the child (Diagram 8).

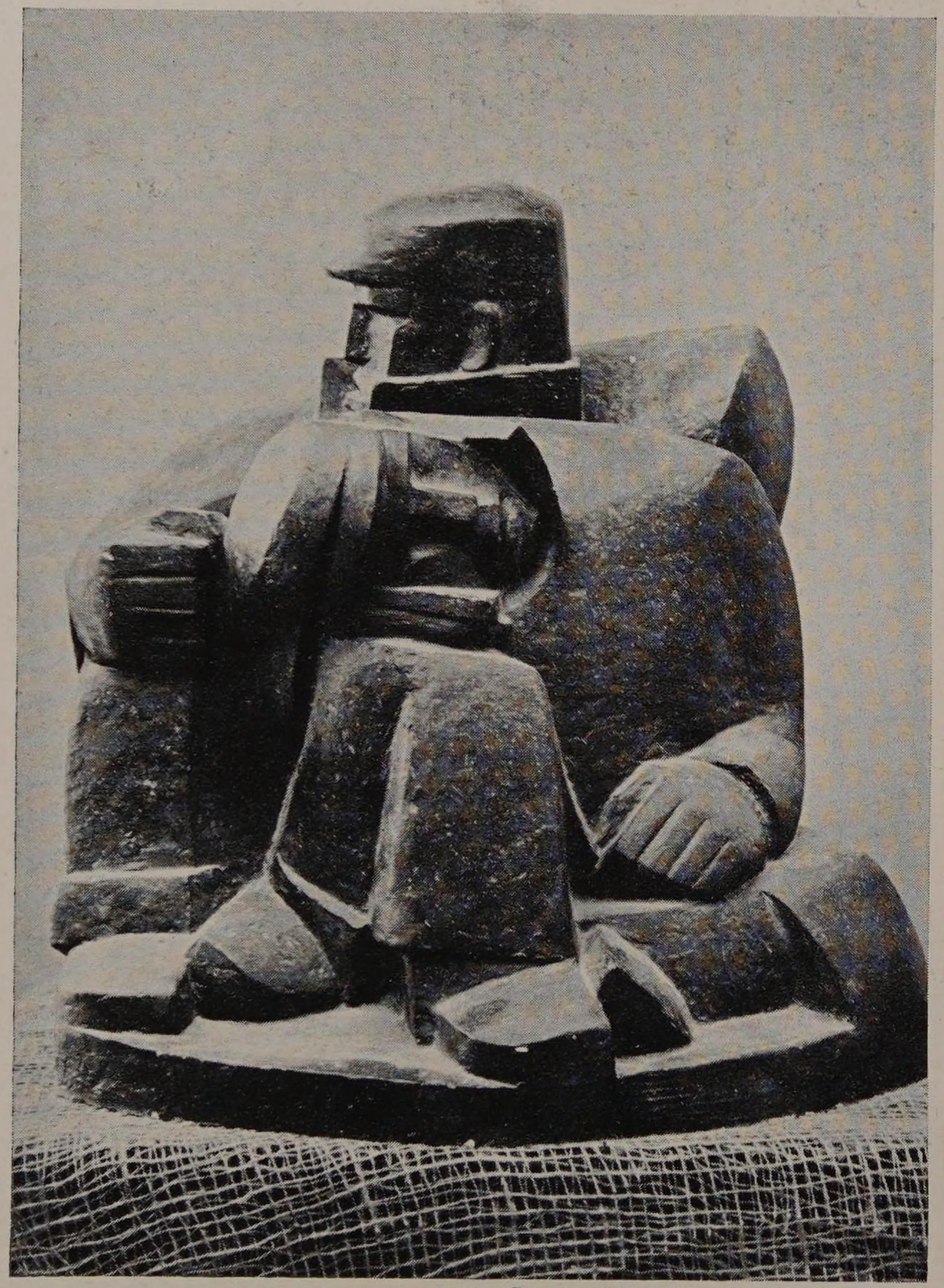
Having thought thus far, we can certainly leave further details to be worked out later, for we now have a definite goal, a definite pattern to be designed. This time, instead of building up the forms bit by bit, as we have so far, let's be *real* sculptors and carve our composition out of a solid block: with the aid of a wooden mallet, the first step is to build up a fairly symmetrical pyramidal mass (Plate 18). As an aid to symmetry, a perfect square, previously drawn on your board, will be useful, and if you add a mark in the center of each side of this square, you can check the central axis of the pyramid by plumb line. This, held at arm's length against the apex of your mass, should fall at this central mark on all four sides.

The preliminary cutting away of the clay you don't need should be done boldly but simply, leaving as many surfaces as possible untouched. The series of photographs in Plate 18 demonstrate the method. Nothing is *modelled,* yet; all the masses are indicated by large, flat planes and straight lines, and the original form of the pyramid is still strongly apparent. If your tastes run to very blocky and "cubistic" sculpture, you may leave your experiment at this stage, without developing it further. Aaron Goodelman, in his "Homeless" (Plate 19), carried his composition (based on the cube) very little further, yet it tells the whole grim and pitiful story as well as being an exceptionally fine design.

Do not be discouraged if exercises such as these prove difficult and rather beyond you at this stage. Even if the results are very disappointing, the fact that you are using the right approach, and thinking of your composition as a geometrical unit, will help you later on and will open your eyes to what other sculptors are doing in this line.

If you do not care for the starkness of geometrical forms, and yearn to make your work realistic and lifelike, you have a perfect right, once your composition is properly massed, to add grace and expression by modelling details until it assumes the "human" qualities of Plate 20.

There is a wealth of tenderness in Andreotti's study of a workman with his baby (Plate 21), but you may be sure that with his very first conception of the subject he



Courtesy WPA Federal Art Project

PLATE 19. "Homeless." Aaron Goodleman



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PLATE 20. Woman, Child and Dog Developed



PLATE 21. "Fiorenzo." Libero Andreotti

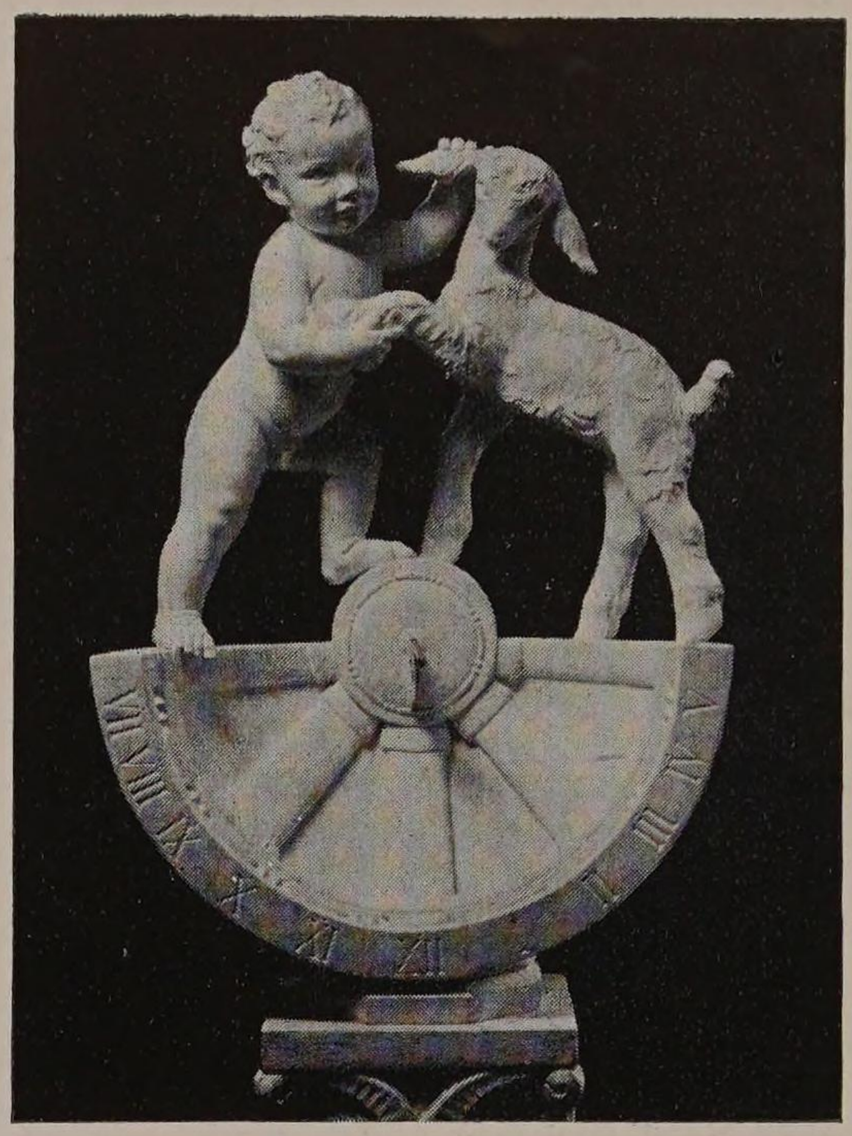
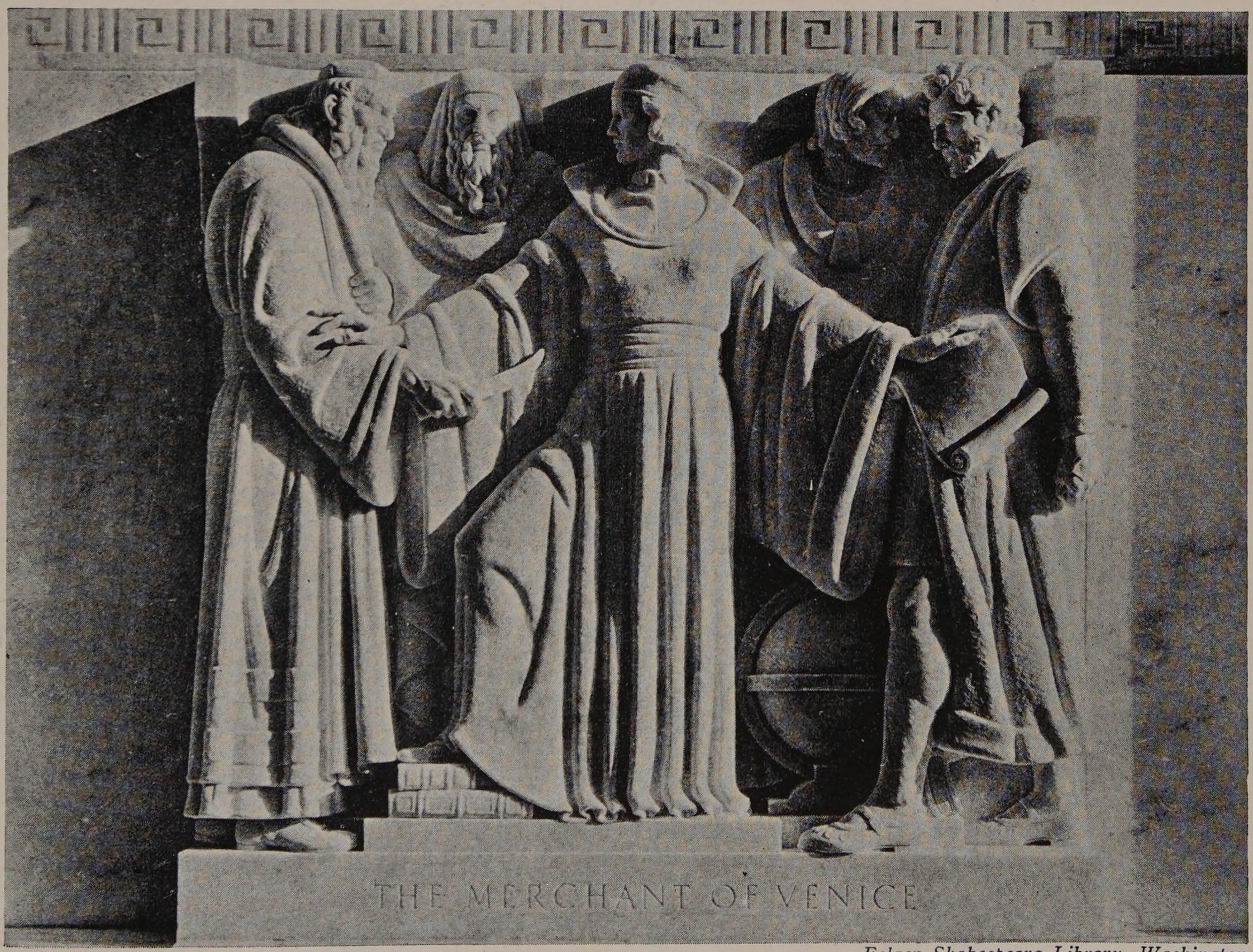


PLATE 23. "Two Kids." Brenda Putnam



Folger Shakespeare Library, Washington

PLATE 22. "The Merchant of Venice." John Gregory

decided to fit his composition within the boundaries of a lunette, or hemisphere. He piled up his clay first of all into this basic mass, *then* added or subtracted what was needed to give the thing life. Notice how he has made not a single *hole* in his group. It makes one think of what Paul Gauguin once wrote about sculpture: "Sculpture should have *bumps* but never *holes*." Now this work of Andreotti's, though modelled in the round, is actually almost a relief, in that all its interest is concentrated on one side. But in all kinds of relief, from the lowest to the boldest, the same geometric laws obtain, though these are laws of plane, not solid, geometry. I think one reason why John Gregory's "The Merchant of Venice" panel (Plate 22) is so completely satisfying, is his superb use of geometrical units within the almost square block. Portia herself makes an important central triangle, while the two upper halves of the composition are smaller inverted triangles and the two antagonists, facing each other, form a column on either side. Notice how the peril of a "hole" under Portia's left sleeve has been adroitly avoided by the placing of a globe on the floor, between her and Antonio. Plate 23 shows a composition based on the circle, or hemisphere.

It is quite surprising, once you begin experimenting, how many ways there are of eliminating holes in your groups. Drapery, foliage, all sorts of possibilities will come to mind as you work. Many sculptors, particularly those who do animals, avoid the great holes under the animals' bodies by simply *filling* in, if they work in clay, or by *leaving* in, if they work in stone or marble. (See Plate 111, page 211.)

The conception of sculpture as a unit, a single mass, is as old as the hills. Those who carve in stone inevitably think it that way, and Michelangelo certainly had that in mind when he said that one should be able to take a *good* piece of sculpture and roll it down hill without breaking off anything. It was not until after his day that the use of bronze became popular and widespread. And with the use of bronze, with its far greater possibilities for freedom of movement and action, came a new phase of sculpture.

FIGURES IN ACTION

Action in sculpture appeals to everyone, as does lively movement in music. Only the few may thrill to the majestic glories of a Beethoven adagio, but who can resist the contagious rhythms of a Viennese waltz? Even though serious sculptors believe that sculpture reaches its highest form in the compact and fairly static mass, they should not be so narrow-minded as to exclude the lighter and airier aspects of the art, provided these be equally *well-done*—well-thought-out, well-balanced, well-modelled.

This is not, by any means, as easy as it looks. I have seen many an able sculptor fairly "sweating blood" over a gay and dancing figure which, when completed, gave an impression of joyous and unlabored spontaneity. One has to know a great deal about the human or animal figure to be able to interpret it convincingly in violent action; to make it obey the laws of gravity and, at the same time, to design it so that its rhythms flow together and its *silhouette* is pleasing from every viewpoint. To model thus, one must thoroughly understand anatomy, and the possibilities and restrictions imposed by the natural construction of the human or the animal figure. Such things you will, I hope, learn in time. Later chapters in this book will at least start you on the road to such knowledge.

But there is no reason why you should wait to acquire this before you begin experimenting with single figures in action, provided you begin in the following manner:

PIPE CLEANERS

Go to the nearest tobacconist and lay in a supply of ordinary pipe cleaners (5 cents a package). These fuzzy white wires come about 6½ inches long and are flexible enough to bend in any direction.

Temporarily, we lay aside clay and tools. We stop modelling for a while to experiment with these little wires, twisting them together into a semblance of the human body. Provided the main lines of the figure are expressed, what is the need of anything more? Modelling would be quite superfluous. The wires tell the whole story.

For a human figure, take two wires and lay them together with one end ¼ inch lower than the other. This extra bit at the lower end will serve as a support for your tiny figure when later you stick it into a small hole in a board. The corresponding bit at the upper end may be bent over to indicate the head. Now, beginning about 3½ inches from the "feet," twist the two wires together to form body and neck. Separate the two legs slightly at the hips; then take a third wire to form shoulders and arms. This wire will prove a trifle too long for good proportion, so you should snip off about ½ inch before you twist the center of it firmly around the first two, just below the "neck."

FUNDAMENTAL PROPORTIONS

Center of body falls at hips.
Length of legs equals body, neck, and head.

Center of leg falls at knee, unless figure is up on toes, in which case, lower leg must be slightly longer than thigh.

Center of arm falls at elbow.

In a 6-inch figure, shoulders should not be more than 1½ inch wide. Hips about ¾ inch.

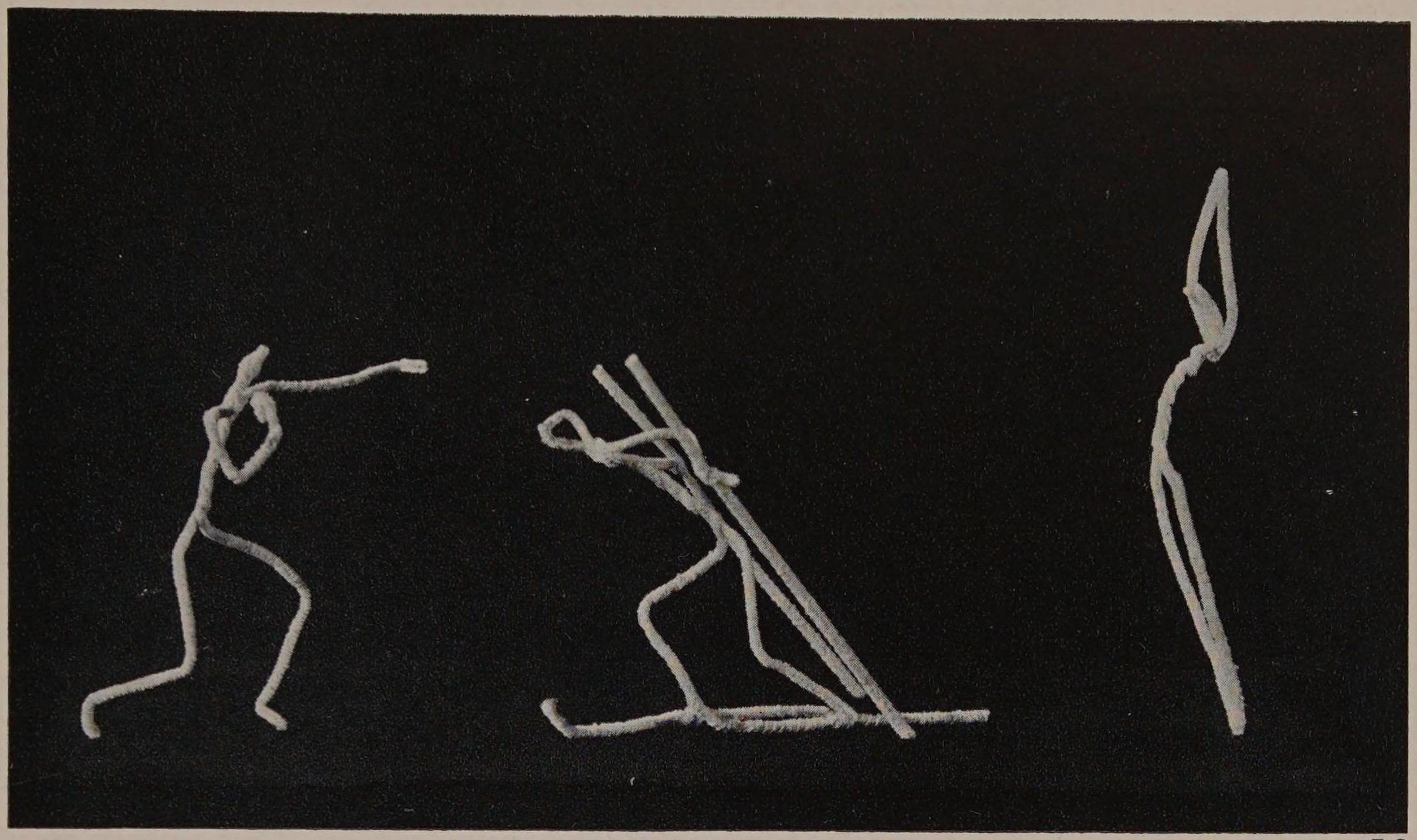
These first rules of proportion *must* be obeyed, if your little figure is to look right. Curiously enough, very few of us see proportions correctly. We nearly always make heads too big, shoulders too broad, arms too long and legs too short. This instinctive tendency may, for all I know, be a throwback to our prehistoric cave-man ancestors. Whatever its origin, it must be nipped in the bud *now,* for nothing is more ungainly, especially in figures which demand swift action and flow of line, than the proportions of an ape!

Remember, too, that you are now interpreting the human skeleton, which is composed of rigid bones joined together at intervals. Your wire may bend at the joints and throughout the body, but it must not bend between hip and knee, or between forearm and upper arm, etc.

The subject you choose is entirely your own affair. Those shown in Plates 24 and 25 are merely a few suggestions. Skating poses would make excellent material and, no doubt, you can think of many others.

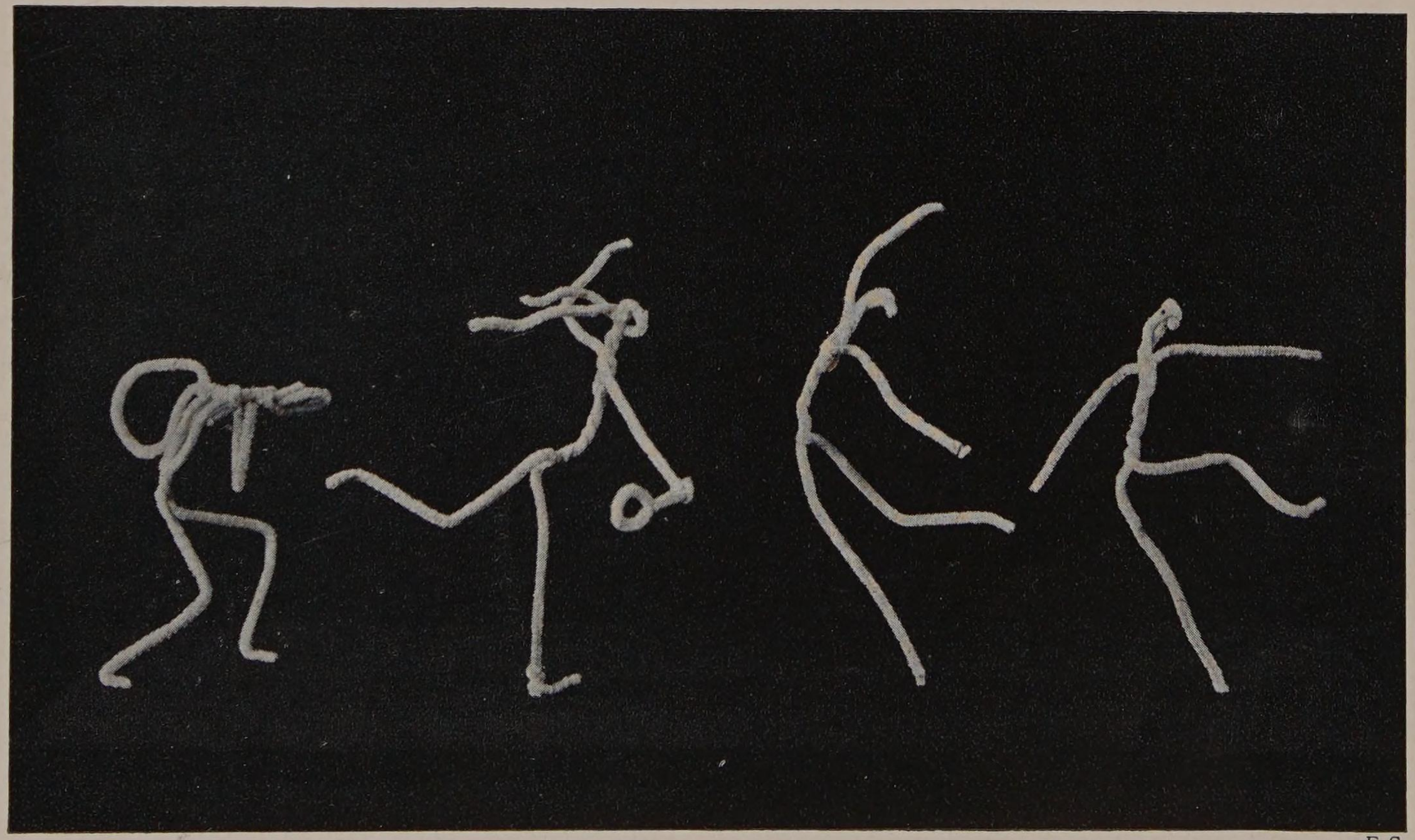
In these days of Sunday newspaper supplements and countless "candid camera" magazines, there is always a wealth of material, much of which would lend itself beautifully to sculptural treatment. No need to employ a professional model to pose for weary (and expensive) hours, in order that one may make a "pipe-cleaner" study of dancer, swimmer, marathon runner. The student should compile a number of scrapbooks of such action poses as most appeal to him; such a library of photographs will prove useful, not only during his student days, but all through his career.

Photographs of horses and dogs, running at full speed, will frequently give the student a truer understanding of *what happens,* than would hours of careful observation at the race track, for the speedy lens catches and holds what the human eye sees only as a rapid blur. In this connection, it is interesting to note that in the days before the invention of the camera, even distinguished painters like Géricault made quite absurd (though understandable) mistakes in painting horses in action. Géricault depicted his running horses with all four *extended* legs off the ground at the same time (like the familiar rocking horse of our childhood days). But the camera has proved beyond dis-



E.S.

PLATE 24. Boxer, Skier, Diver



E.S.

PLATE 25. Old Man with Bag, Tennis Player, Dancer, Baseball Pitcher

pute that the only time a running horse has all four legs off the ground at once is when his legs are *doubled up* under him.

If you live in a city with a large public library, the chances are that you will find there some fascinating books of photographs by Eadweard Muybridge, showing hundreds of consecutive pictures of human beings and animals in action. These pictures, though taken many years ago, are still of the greatest value to the artist. They were the precursors of the motion picture: rapid "shots" of each phase of a single action, like that of a horse taking a barrier, and then printed one after another along the page.

Here is one more rule for you to follow in making little wire figures. When the figure is *poised,* not actually running full tilt, and without extraneous support, the *pit of the neck* must *always* be in perpendicular line with the *ball of the foot,* or inner anklebone. Otherwise the center of gravity is lost and the figure will look as though it would topple over. This does not mean that the entire body must be on a straight line—far from it. The whole body may swing forward, back, or sideways, provided always that its upper part swings back again in time to bring the pit of the neck directly over the supporting foot. In Plates 24 and 25, the dancer, the diver and the baseball pitcher illustrate this very important point. In such figures as the old man or the boxer, the weight is equally distributed between both feet, and the pit of the neck falls on a perpendicular line *between* these two feet. The skier, even, by flexing his legs at hip, knee and ankle, and bracing himself by his hamstrings, can thrust his neck forward *beyond* his feet. He could not do this, however, if he straightened his body and legs. Try it yourself and see, but first lay a pillow on the floor where your nose will strike, for you will inevitably topple over! Harriet Frishmuth's enchanting "Bubble Dance" (Plate 26) is perfectly poised, with the pit of the neck exactly over the supporting foot.

SOME AESTHETIC CONSIDERATIONS

In this book I am trying to be of as much practical help to you as possible, without forcing upon you too many preconceived theories concerning the purely artistic values in sculpture. But there are one or two elements at the bottom of all truly beautiful sculpture (and by beautiful I do not mean pretty), which you should strive to infuse into your own work.

The Line of Beauty

Sculpture must have rhythm, even as music must. And one of the surest ways of giving rhythm to your work is to make the most of the *line of beauty* which is to be



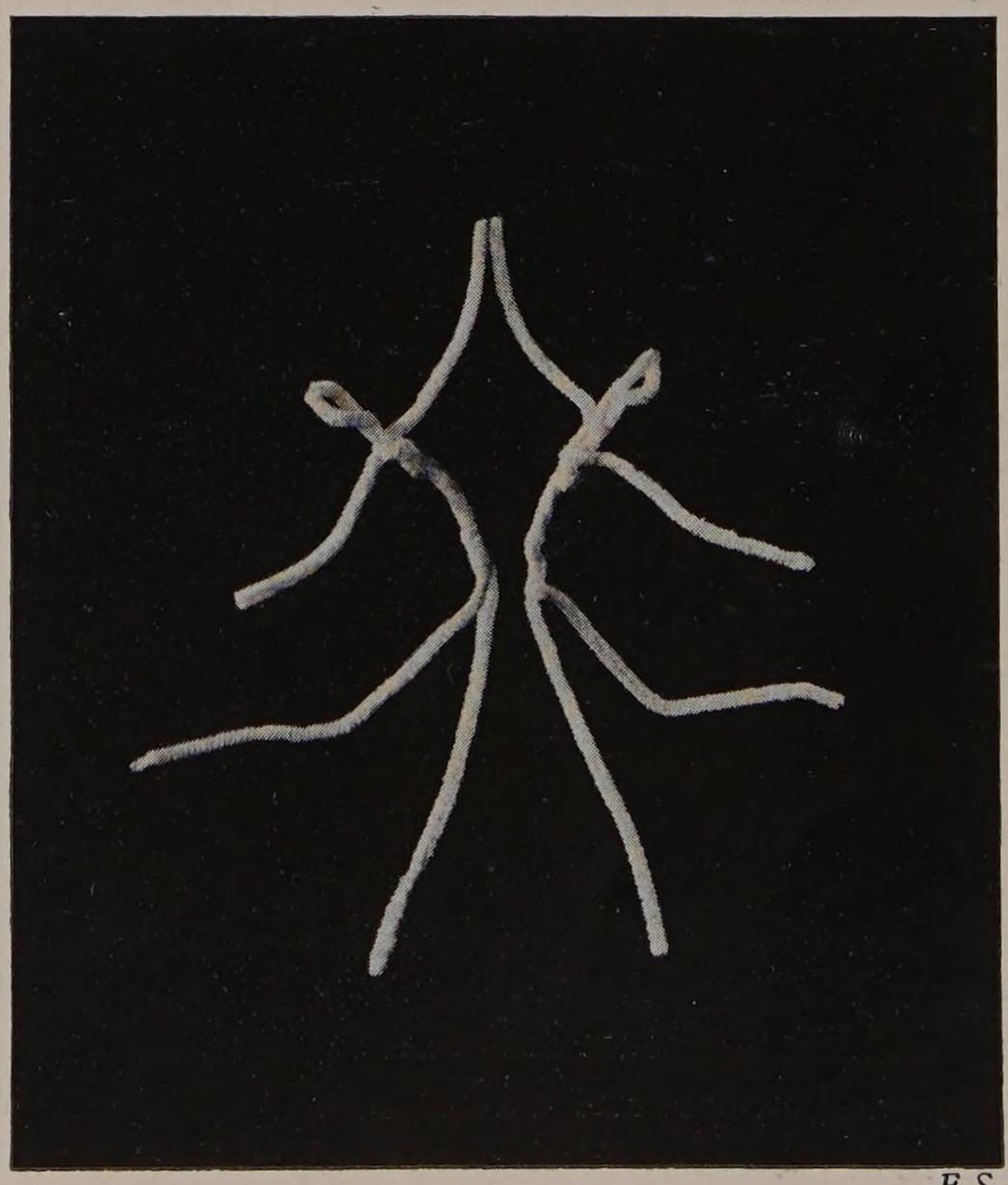
Courtesy The Gorham Company

PLATE 26. "The Bubble Dance."
Harriet W. Frishmuth



E.S.

PLATE 27. Dancing Pair, Parallel



E.S.

PLATE 28. Dancing Pair, Symmetrical

found everywhere in nature. It was the English painter, William Hogarth, whose amusing monograph on the subject first made me stop and analyze this lovely line of which I had for years been only instinctively aware.

Hogarth, one day, was sitting looking out of the window. Across the street was a high stone wall, and over against this wall a man walked by. Hogarth, with a swift stroke of his pencil, noted the way the man's head moved up and down with each step, tracing an invisible line along the wall. And this line, as translated by Hogarth, was not straight, but undulating.

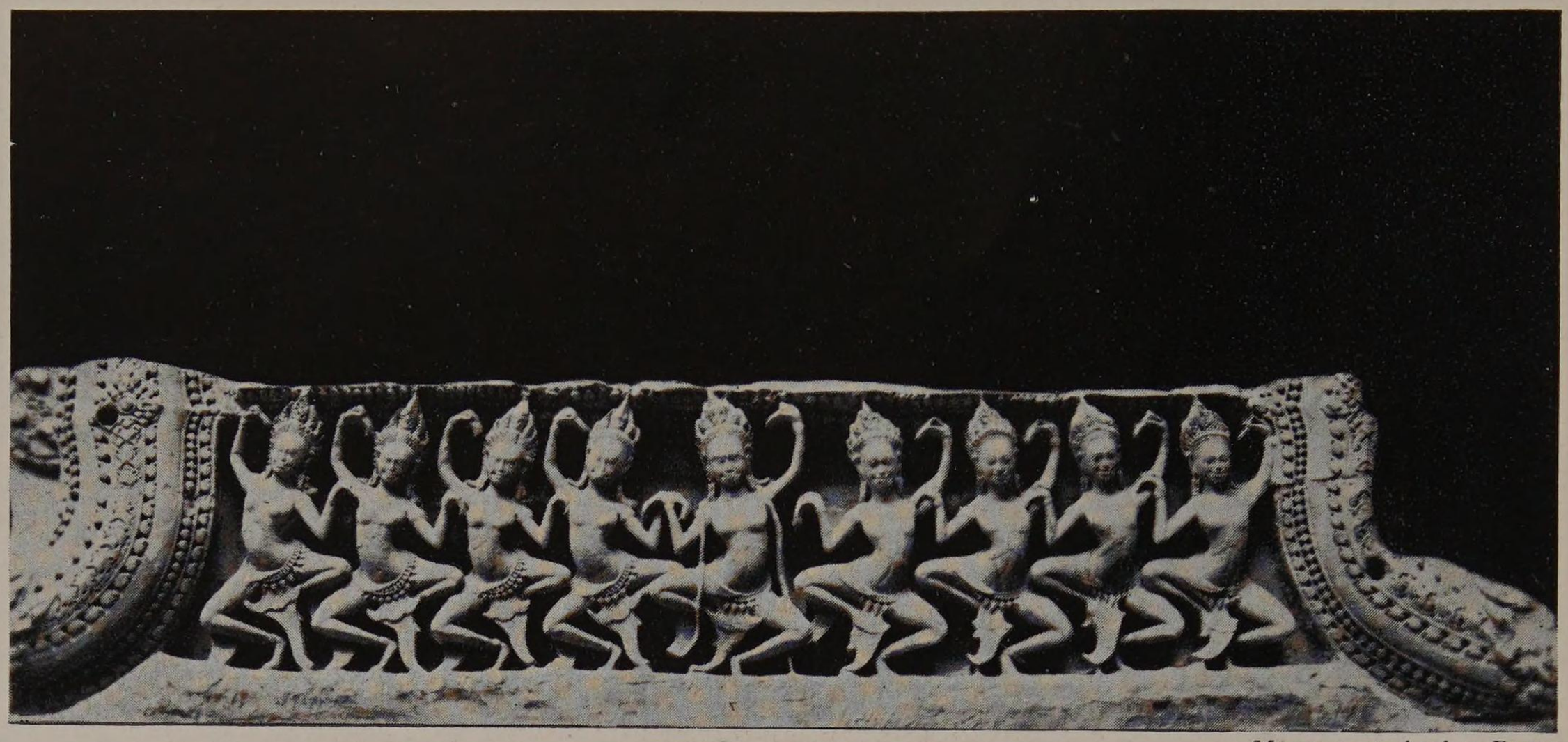
"Beautiful!" cried the artist. "*This* is the line of motion, of rhythm, of all living things. It is the Line of Beauty." Whereupon, he embarked on some experiments. The most amusing is a series of pictures of a lady's "stays," or corsets of the period. Using about a dozen profile views of the same subject, he drew the first pair of stays with perfectly straight, rigid outlines. "Ugly!" quoth he. In the next picture, he gave the straight lines just a suspicion of a curve. In the next, he curved them still more, and so on, until the last grotesque object bulged in and out with a horrid implication of unwieldy fat, grossly caricatured. "Ugly!" quoth he again. Then, selecting the *central* picture of the series neither too straight nor too curved, he cried: "Only this one is truly beautiful!" and sat him down to write a book about his pet discovery.

That line, like an elongated *S,* is the one by which primitive man indicated water, from which all life sprang. It is the curve of a wheat field under wind—the curve of a swan's neck. And most important of all for us sculptors, it is the curve which nature has given to our own backbones. Indeed, there are many lines of beauty to be found throughout the human form, but that of the spine is the most important of all. In profile, moreover, the whole lower limb also follows such a line, as the thigh curves slightly forward and the calf makes the reverse curve backward. In my little wire figure of the "Diver," the entire pose, from fingertips to toes, was suggested by the line of beauty. I have seen Sonja Henie, poised on one silver skate, reach forward with her right arm and backward with her left leg, until the entire sweep of her body was a single "line of beauty."*

*Once you have learned to appreciate this curving line, and to seek it in art and in nature, you will be astonished to find how prevalent it is. Use it freely in these first figure experiments, but remember that nature also rings changes on this lovely curve, once in so often, by bringing it up short against a straight line or a plane surface—lest we tire of its sweetness. A figure composed entirely of lines of beauty would be an insipid thing and, should the curves be too pronounced, something closely resembling Gelett Burgess' "Goops" might be the unfortunate result!



PLATE 29. Archers, *Woodcarving*. Ivan Meštrović



Museum at Angkor Bayon

PLATE 30. Frieze of Dancers, *Stone*

Parallel Lines and Repeated Patterns

Nothing so emphasizes a given line which you wish to stress, as immediate *repetition* of it. For instance, if you wish to give the dancing figure in Plate 25 a partner, it would be good design to have his main line, or direction, follow hers. These parallel central lines thus become the main theme or direction of your group (Plate 27). An example of the cumulative effect of repeated lines (this time sharp and angular) may be found in Meštrović's superb wood carving of the archers (Plate 29). Sometimes not just a single line, but the entire design, is repeated over and over with delightful effect, as in this frieze of dancers from the Musée Indo-chinois, at Angkor Bayon (Plate 30).

Another experiment with the two wire dancers might be to have them make a symmetrical pattern, as in Plate 28. There is a certain fascination about "mirrored" designs. Who of us, as a child, was not thrilled by the duplicate patterns made by dropping a blob of ink on a paper and then folding the paper sharply before the ink had time to dry? Symmetry is a law of nature and we respond to it in many phases, from the twin leaves on either side of a stem, a condor's outspread wings, to the symmetry of the left and right sides of the human body.

It will, I think, surprise you to find how expressive these little figures can be made, despite the fact that they are merely outlines, without modelling or details. Many beginners, when they start modelling tiny figures in clay, fail to realize that these main



Photo by Frances E. Ward

PLATE 31. "Dancer and Gazelles," *Bronze*. Paul Manship

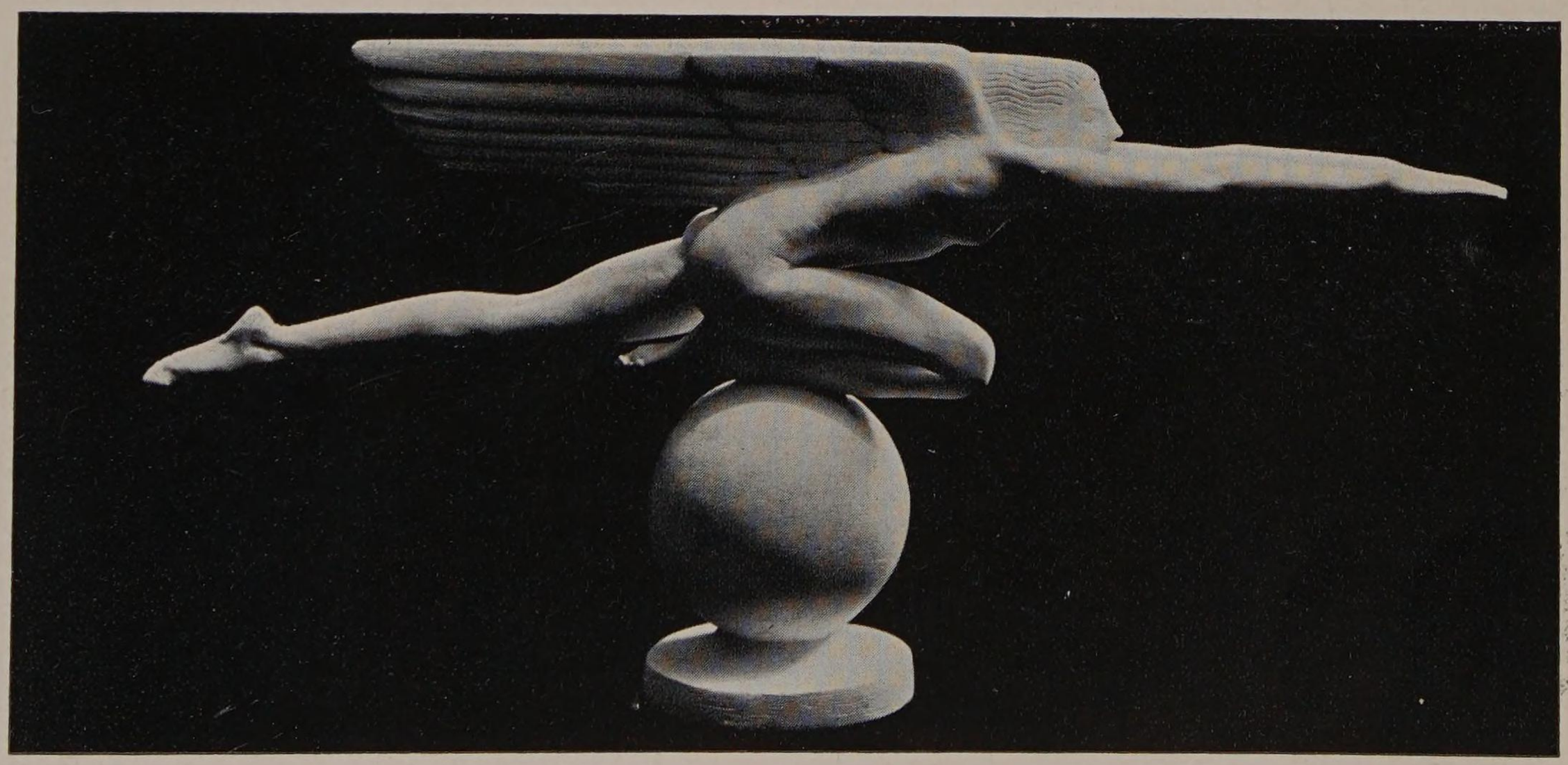


PLATE 32. "Speed." *Plaster*. Harriet W. Frishmuth

lines are the most essential part of a figure. Instead of concentrating on the major action, they expend much fruitless effort scratching in minute faces, fingers, toes and other details that do not add a whit to what they are trying to express.

When you do lay aside the pipe cleaners and begin modelling small clay figures on a wire framework, try not to become absorbed in such trivialities. After all, in making an eight- or ten-inch figure, one should think of it as being actually a life-size figure, but seen from such a *distance* that all details have vanished, and only the big general masses and lines remain to tell the story.

The silhouette, in single figures, is of paramount importance. A compact group, such as we studied at the beginning of this chapter, need not necessarily have an interesting outline.

Its interest lies mainly in the forms within the geometric unit. But a single figure, in free action, should be so designed that seen simply as a silhouette—light against dark or dark against light—its *contours* make a satisfying design from all points of view. And not only the shape of the figure itself must be taken into consideration, but even the *spaces* between the various parts of the figure must be thought of! The good sculptor literally designs these spaces with almost as much thought and care as he expends on the figure itself.

Paul Manship's rhythmic "Dancer and Gazelles" was, you may be sure, thought out with due regard for the spaces between the figures (Plate 31). Notice, too, how exquisitely balanced the whole design is.

Balance is an important element which must not be overlooked in one's first attempts to express action and speed. The extraordinary gymnastics of which the human form is capable in passing through a series of violent actions, though possibly amusing material for the candid camera, are definitely unsuitable subjects for the permanent art of sculpture. One would quickly tire of looking at a pose which one knows could not be held for more than a split second and in which the body is thrown disconcertingly off its center of gravity.

One of the best solutions of action combined with poise and balance is the radiator cap emblem, by Harriet Frishmuth (Plate 32). Swift as is every line of this little figure, the weight is so evenly distributed over the supporting ball that its balance is perfect and we can enjoy the sense of speed without any uncomfortable feeling that the figure will fall.

Lastly, I think you will find it interesting to compare Plates 33 and 34. The glorious



Courtesy Museum of Modern Art

PLATE 33. "Unique Forms," *Brass.* Boccioni



Courtesy Metropolitan Museum of Art

PLATE 34. "Winged Victory" of Samothrace, *Marble*

"Winged Victory" has thrilled countless thousands of awestruck visitors ever since she was discovered. "Here," cries the beholder, "is the very acme of sculptured motion. What a superb swirl of wind-blown drapery over the triumphant and swiftly moving figure. No other sculptor will ever be able to hold a candle to the genius that created this!"

Just a few years ago, at the Museum of Modern Art in New York, appeared Boccioni's "Unique Forms of Continuity in Space." And in order to give the public a chance to compare for themselves, the clever person who arranged the exhibition placed near Boccioni's polished metal fantasy a plaster cast of the "Winged Victory." Did the modern sculptor have this Greek work in mind when he wrought his bizarre but undeniably forceful striding, wind-blown figure?

CHAPTER IV

MODELLING IN RELIEF

VARIOUS TYPES OF RELIEF

BAS-RELIEF might be described tersely as a raised drawing. Two of its dimensions, length and breadth, are as "factual" as in painting or in sculpture in the round; but the third dimension—depth—is variable and depends wholly upon the type of work. In "haut-relief," as the French call it, the figure is modelled almost as round as in real life; while in "bas-relief" the projection may be as slight as one eighth of an inch, as in some of Saint-Gaudens' exquisite portraits (Plate 37).

The first great masters of relief were undoubtedly the Egyptians. On the soft stone of the interiors of their tombs are to be found some of the most beautiful patterns in the world. Though their work lacked both realism and perspective (or perhaps because it lacked them), their designs, the spacing of their groups, the delightful rendering of decorative details, are an inexhaustible source of inspiration to the artist.

Many of us who have seen only isolated examples of Egyptian sculpture in museums, far removed from their natural setting, find it stiff, stolid and unbeautiful. The figures look awkward and unlifelike to those who are familiar only with the art of the past few centuries. But when we understand where and why this "four-square" architecture and sculpture was created, we realize that it is the only kind of art absolutely appropriate to the Egyptian landscape, and to the beliefs and traditions of the Egyptians themselves.

The valley of the Nile is an uncompromisingly horizontal landscape. The river has carved its way through great level stretches of limestone cliffs. The cliffs are flat and horizontal on top, while the valley below them and the desert sands beyond are equally level. Furthermore, the strata of the cliffs themselves are perpendicular. As Sir Flinders



Courtesy Metropolitan Museum of Art

PLATE 35. Egyptian Relief, *Early Period*

Petrie cogently remarks: "In the face of such an overwhelmingly rectangular framing, any architecture less massive and square would be hopelessly defeated." And the sculpture, very properly, suited the architecture.

Just as, thousands of years later, the Gothic sculptors made long, attenuated figures to conform to the aspiring lines of cathedral architecture, so the Egyptians made their figures as vertical and horizontal as it is possible to make the human figure.

As has already been intimated, relief is a development of drawing. All children draw before they carve or model, and the earliest Egyptians drew their reliefs as children draw. As Margaret A. Murray points out in her book *Egypt:* "The child draws from memory and not from the object; he always represents his subject from the broadest point of view—as when he draws animals or boats in profile. But to represent a human



Courtesy Metropolitan Museum of Art

PLATE 36. Egyptian Relief, *Later Period*

figure is a very different matter without knowledge of foreshortening. If the figure is drawn full-face, how are nose and feet to be shown? In profile, eyes and shoulders are an insuperable difficulty. But the primitive artist is not to be deterred by difficulties. He wishes to show both legs and both feet, so he draws them in profile, one in advance of the other; both arms have to be shown—the body, therefore, must be drawn in front view, this being also its broadest aspect. The head is again in profile, but as the shape of the foreshortened eye did not impress itself upon the mind of the artist, he drew it as seen from the front."

Although this quaint method of depicting the human figure was evolved very, very early in Egyptian history, it proved in the main so appropriate, so fitting to the requirements of the architecture, that it remained the traditional standard for many centuries after the artists had learned how to foreshorten. We have ample proof that in later centuries they did learn to draw figures in true profile, when they chose—but they seldom chose. They preferred what is today called the "law of frontality"; that is, making as much of the figure as possible face toward the spectator, and they obeyed

this law not only in their reliefs, but also in the massive figures which they hewed out of blocks of granite. Only such architectural and geometrical conceptions of the human form satisfied their innate sense of the fitness of things and expressed their agelong yearning for everlasting permanence.

Now these Egyptians made two different kinds of relief, equally flat and formalized. In very early times the figures were slightly raised; that is, the sculptor carved down the background all around the figures (Plate 35). In later centuries he began by deeply incising the outline of the figure; then, leaving the background untouched, he carved and "modelled" the surfaces of his figure. As a result the design does not project from the surface at all—indeed, is slightly below it (Plate 36). Just why this interesting treatment of relief should have been completely abandoned during later art periods is a mystery. Why it has not yet been widely used, as an adjunct to present-day architecture, is another. At the time of writing, I know of very few sculptors in this country who have treated relief in this manner. One is Katharine Lane, of Boston, who designed a great frieze of elephants for the brick wall of the Harvard Biological Laboratories. It is to be hoped that, as time goes on, more young sculptors and architects will use this method on the flat façades of modern buildings.

Assyrian sculpture also specialized in bas-relief—vigorous and decorative—but with more dramatic action than we find in Egyptian work—less static, more dynamic.

In Greek sculpture, relief is no longer very flat. It is quite richly modelled. Some of the steles, or gravestones, are miracles of quiet beauty, and artist and layman alike thrill to the grandeur of the Parthenon frieze. Plate 39 gives a very representative detail of the frieze at Delphi, showing Greek relief at its most noble period. High as this relief is, you will notice that every projecting part is flattened and the figures so posed that no foreshortening is necessary. What delightful contrast between the wide, simple planes of the horses' bodies and the elaborate crimpiness of their flowing manes and tails!

In most Roman relief there seems a tendency to overdo, to crowd too many figures into a given area and to depict complicated and conflicting action; to translate into stone the literal pictures of men and their deeds rather than to symbolize the spirit of their achievements. But both Greek and Roman coins and cameos are miniature marvels of bas-relief—of the adroit filling in of a given space with a significant form.

During the Italian Renaissance, Pisanello brought to new heights the delightful art of medallic sculpture (Plate 38). Since his day, however, medallic art has occasion-



F.E.W.

PLATE 37. "Samuel Gray Ward."
Augustus Saint-Gaudens



PLATE 38. Medal, *Obverse*.
Antonio Pisano, *better known as* Pisanello

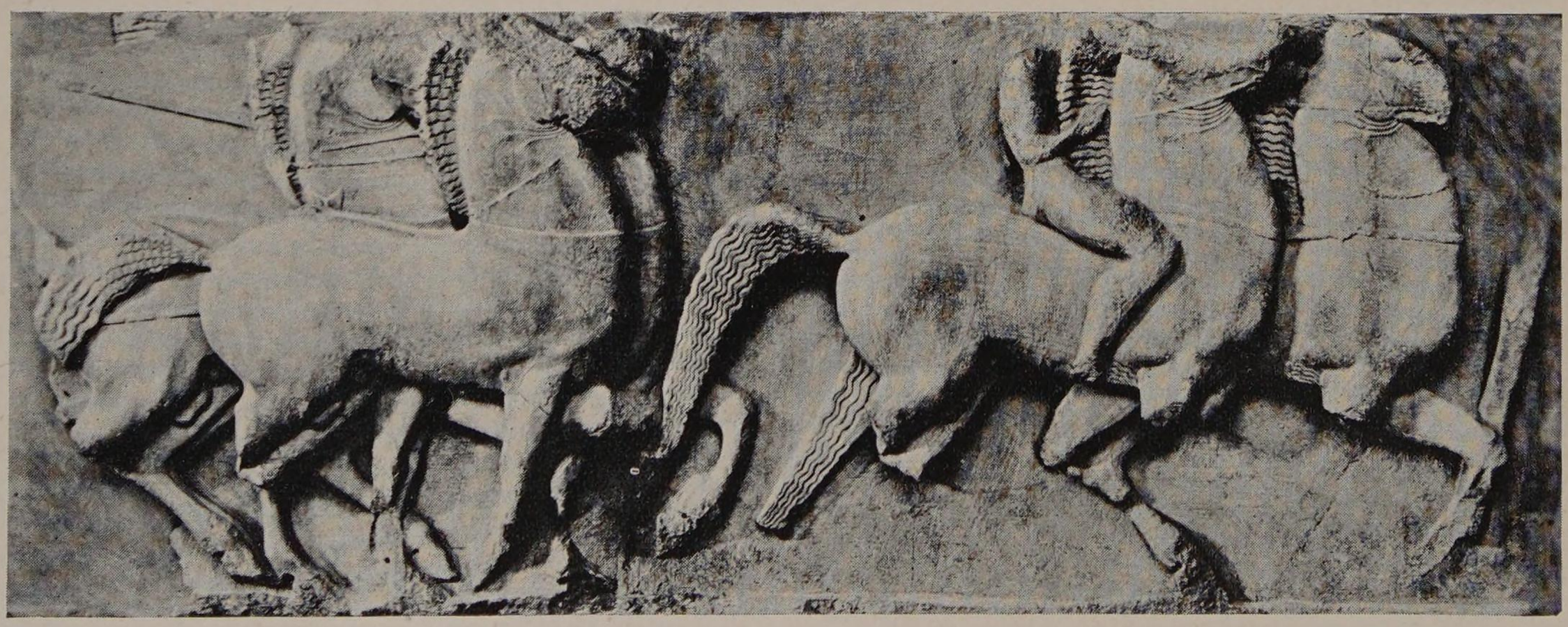


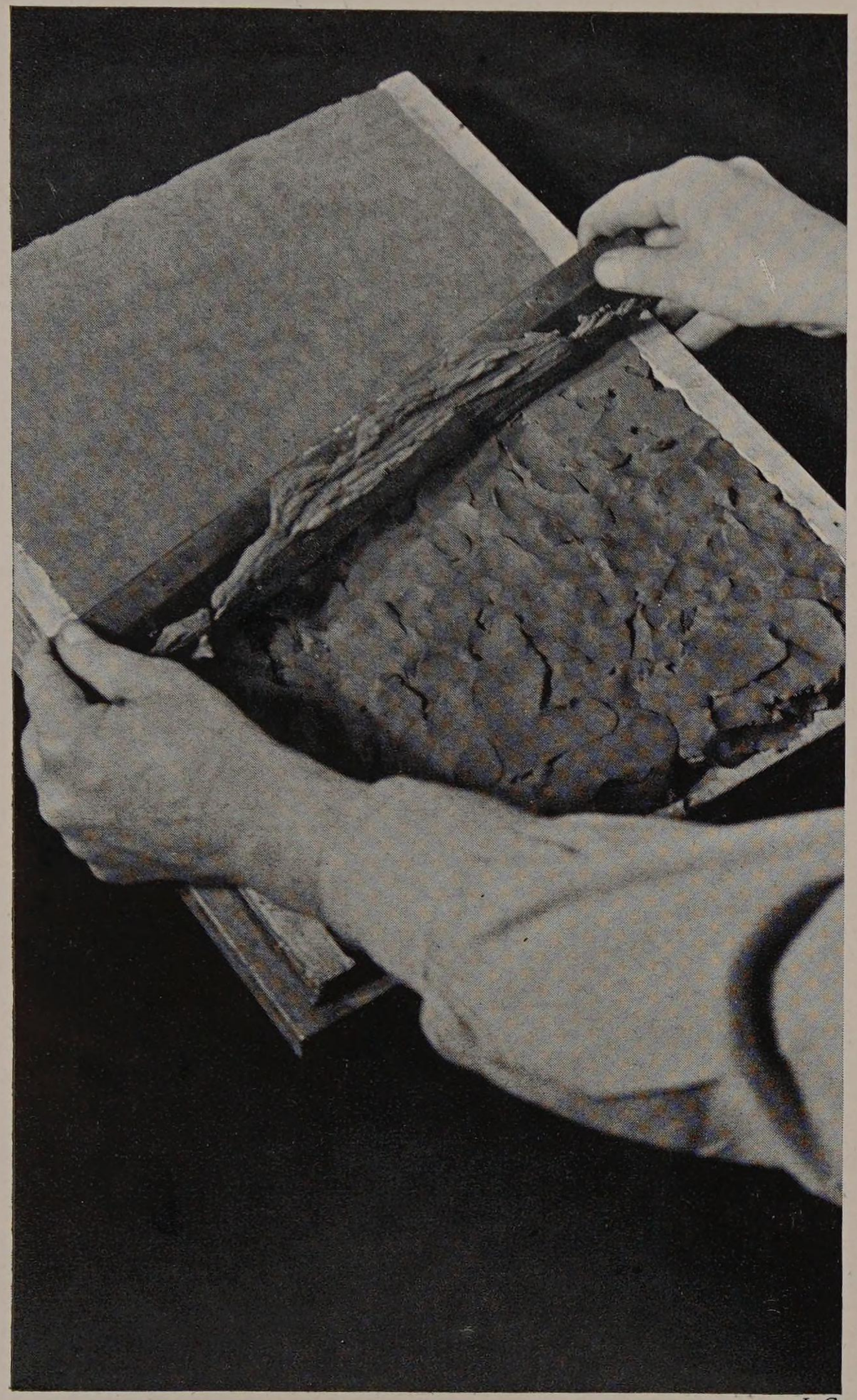
PLATE 39. Parthenon Frieze, *Detail*

ally fallen to very low levels. But both in France during the past century and in America during the present, there has been a genuine revival of interest in this field. French medals are, for the most part, designed more pictorially than sculpturally, but executed with great skill and delicacy; while in this country we tend more toward the standards of the ancients, with bold contours and masses, a strong sense of design and a renewed appreciation of lettering as an intrinsic part of that design. Not only art lovers, but everyone in the United States has the privilege of owning and enjoying at least one coin made by one of our great sculptors. James Earle Fraser designed the "Buffalo" nickel which we so casually pop into the slot of the public telephone. Examine it sometime. It is one of the most beautiful coins we have and I trust will not for many years be entirely superseded by the more recent Jefferson coin. Probably only a sculptor realizes that such minute works of art cannot be modelled so small. What the sculptor does is to model each side of his coin as a separate medallion, about a foot in diameter. The plaster casts of these models are then sent to one of our several mints and there reduced, by means of a most delicately adjusted measuring device, to the size of the coin. From these tiny models steel dies are made, and the coins are stamped out by means of these dies.

With this necessarily brief résumé of the various types of relief, we must now get down to business and find out how one goes about making a relief. There is, and probably always will be, a demand for good bas-relief—either as a decoration for architecture, as coin or medal, or as a means of portraying our fellow man. As this last is what the majority of students wish to learn first of all, we must go into the matter with some thoroughness.

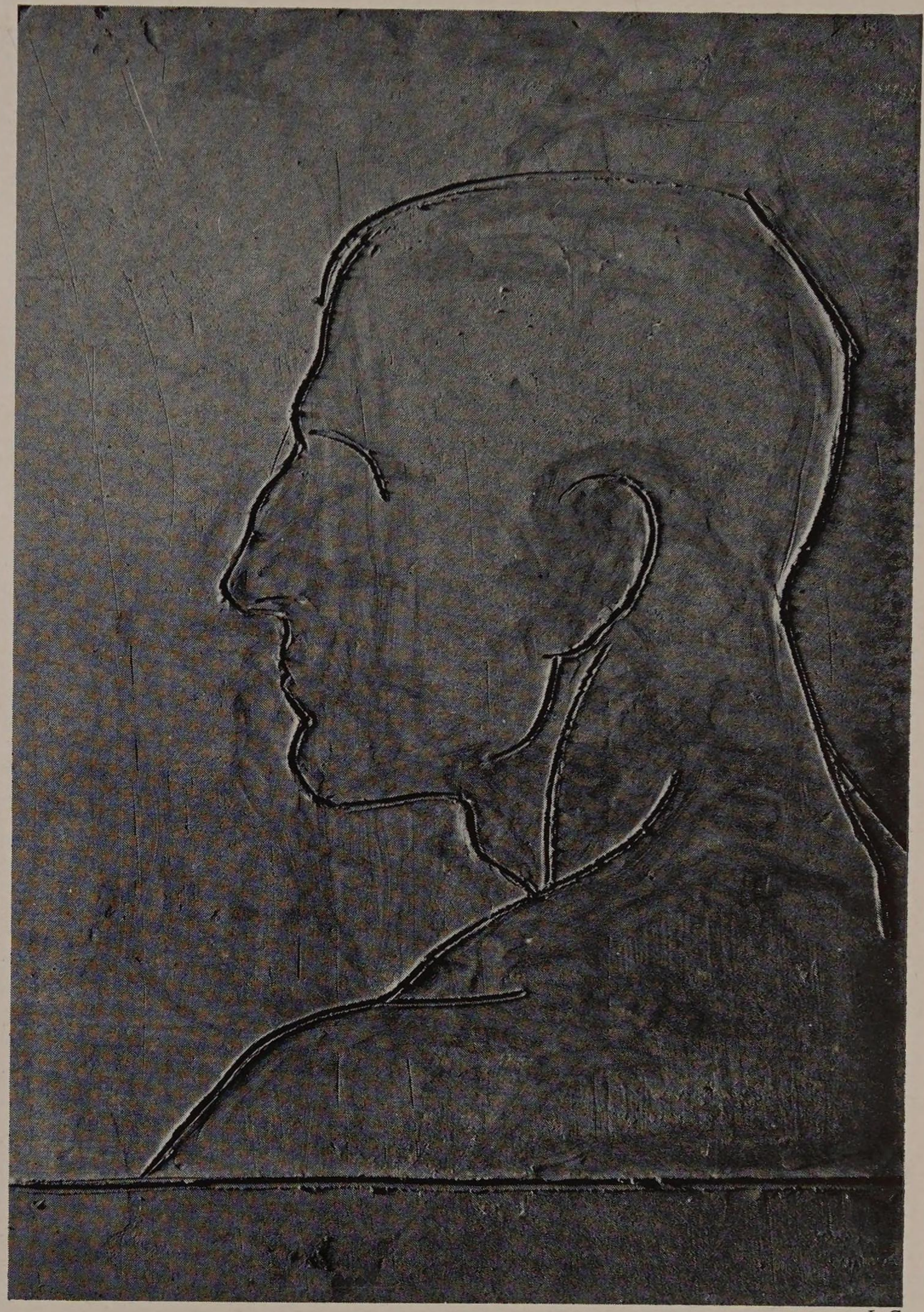
The portrait relief has this practical advantage over the portrait bust; while a bust is more or less of a "white elephant" in a private home, a relief is no more difficult to hang on the wall than a painting and, for this reason alone, more to be preferred by the average family than an impressive bust which requires a pedestal of considerable dignity.

The first requisite for a good relief is good draughtmanship. If you cannot draw an acceptable outline of a head, or any other object, you most certainly cannot expect to model one. But it is to be hoped that along with your first exercises in modelling, you have drilled yourself in drawing with either pencil or charcoal. I assume, therefore, that you can draw the outline of your sitter's head. Plates 40 to 44 show various stages in building up a portrait relief.



L.G.

PLATE 40. Scraping Down the Background



L.G.

PLATE 41. The Background with Outline of Head

Plate 40 shows the quickest and simplest way of preparing a level background on which to work. Along either edge of a board of the proper dimensions, I have nailed two cleats of equal thickness (in this case about three eighths of an inch). These represent the desired thickness of the background. I press my clay, bit by bit, onto the board between the cleats, not smoothing it down but roughly packing it on until it is generally level with the cleats. Then I take a ruler, or other straight edge, and with both ends of the ruler pressing firmly on the cleats, scrape down over the surface of the clay. After this initial scraping, there are a few hollows left which I fill up with more clay, then scrape again. In this way a level surface may be obtained in about half an hour.

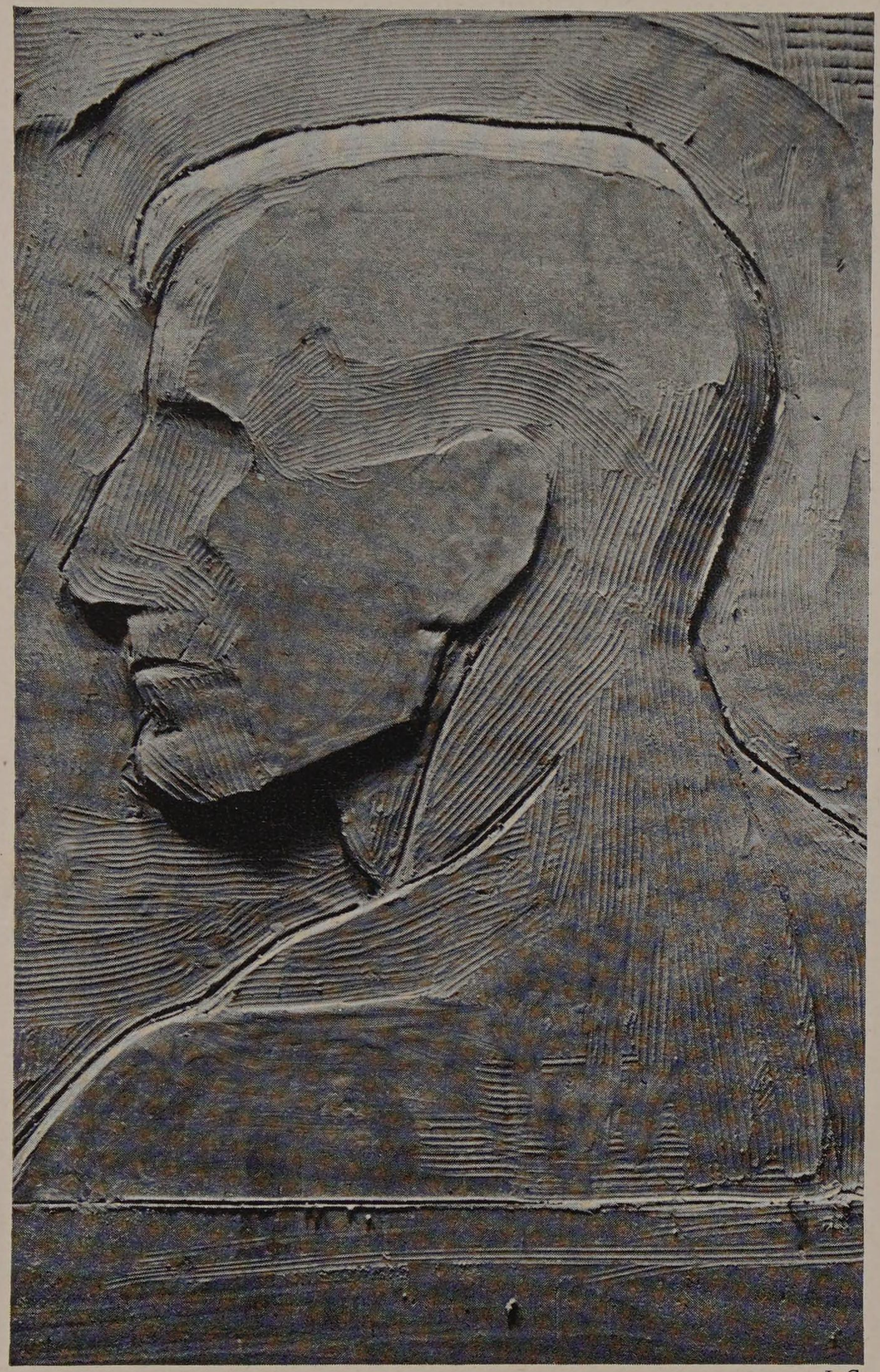
Now, with a tool, the outline of the head is drawn in (Plate 41). The proper placing of the head within the rectangle is as important in relief as it is in painting. One good rule is to allow more background in front of the face than you do behind it.

From this point there are two ways of proceeding: either cut away the background or build up the head within the outline. The first method is the more truly sculptural, like stone carving, and has the advantage of making you keep all the upper surfaces flat, as they should be in good relief. In Plate 42 the start of this method is pictured. Here, the left shoulder and the greater part of head, cheek and ear, represent the surface of the "stone." Not one bit of clay can be added here. If the relief is not yet bold enough, everything *else* must be further cut away. Remember, while you do this, that you are now a carver, not a modeller, and must carve down each successive plane with care, so that you will not be obliged to add to it again later, which of course, in stone, would be impossible.

While you are analyzing these various receding planes it may be helpful to *number* them thus: 1, for the planes nearest you which are not to be cut away at all; 2, for those slightly further away; 3, for those yet deeper, etc., etc. Painters frequently make use of this numbering system when making rapid sketches out of doors which they intend to work up in the studio. The painter numbers the tones, or values, of his picture, with 1 for the lightest parts, and so on down to a possible 8 or 9 for the darkest shadows.

The second process—easier and more generally used for portraits—is to build up, bit by bit and plane by plane, the major forms of the head (Plate 43).

But even here, many a troublesome time awaits the unskilled. If, as was noted at the beginning of this chapter, the depth (or height) of a relief is so variable a matter, what have we to guide us in the rendering of this extremely subtle and variable dimension?



L.G.

PLATE 42. Carving Away the Background



L.G.

PLATE 43. Building Up Within the Outline

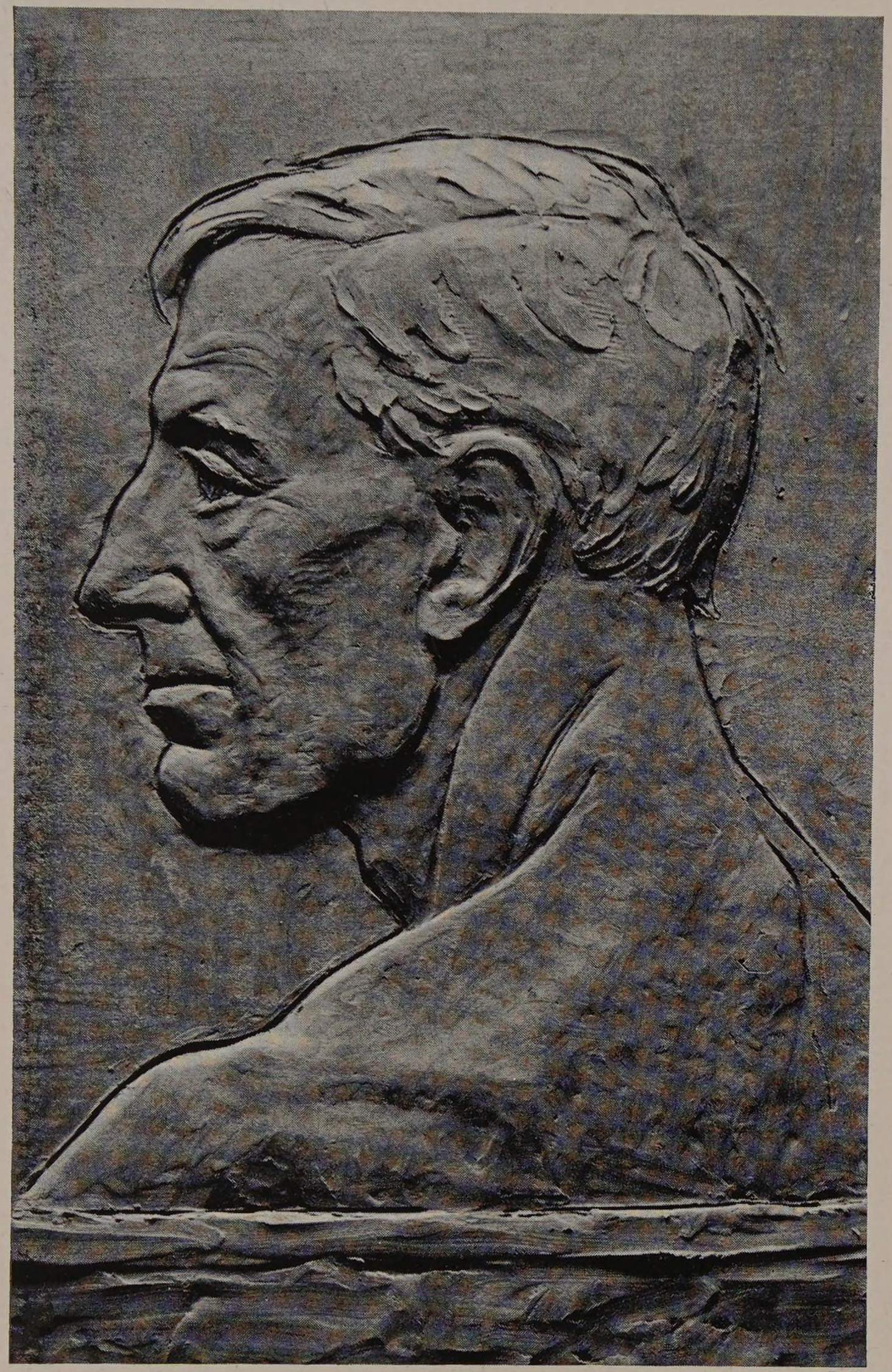
As a result of years of teaching, of seeing every pupil, gifted and untalented alike, stumble into the same pitfall, I have worked out a chart (Diagrams 9, 10, 11) which will, I believe, help everyone to handle this elusive third dimension.

In the chart, one half of a head is "telescoped" from the round to relief. Were it possible to reproduce it, a fourth diagram would be included to show the actual third dimension of the average portrait relief, which is usually no more than ¼ inch. If you have a good example of such relief in your studio, pick it up, hold it "edgewise" and scan the cross section. You will see how amazingly little projection is necessary to give the effect, from the front, of a rounded head.

How is this telescoping achieved? Mainly, I may say, by using common sense and logic. In these diagrams, lines A, B, C, D and E, drawn through the head, represent "logic." In Diagram 9, we have the edgewise view of a head in very high relief, with line E representing the background. When we study our sitter's profile, we notice that his shoulder and his ear are the points nearest to us. In the diagram they fall between lines A and B. Next to these, between B and C, come the head and hair above the ear, the cheek, the jaw and then the neck. The eye lies between the lines C and D, and the nose and mouth somewhere between D and E. At line E (the vertical center of the head) nose, mouth, chin and neck meet the background.

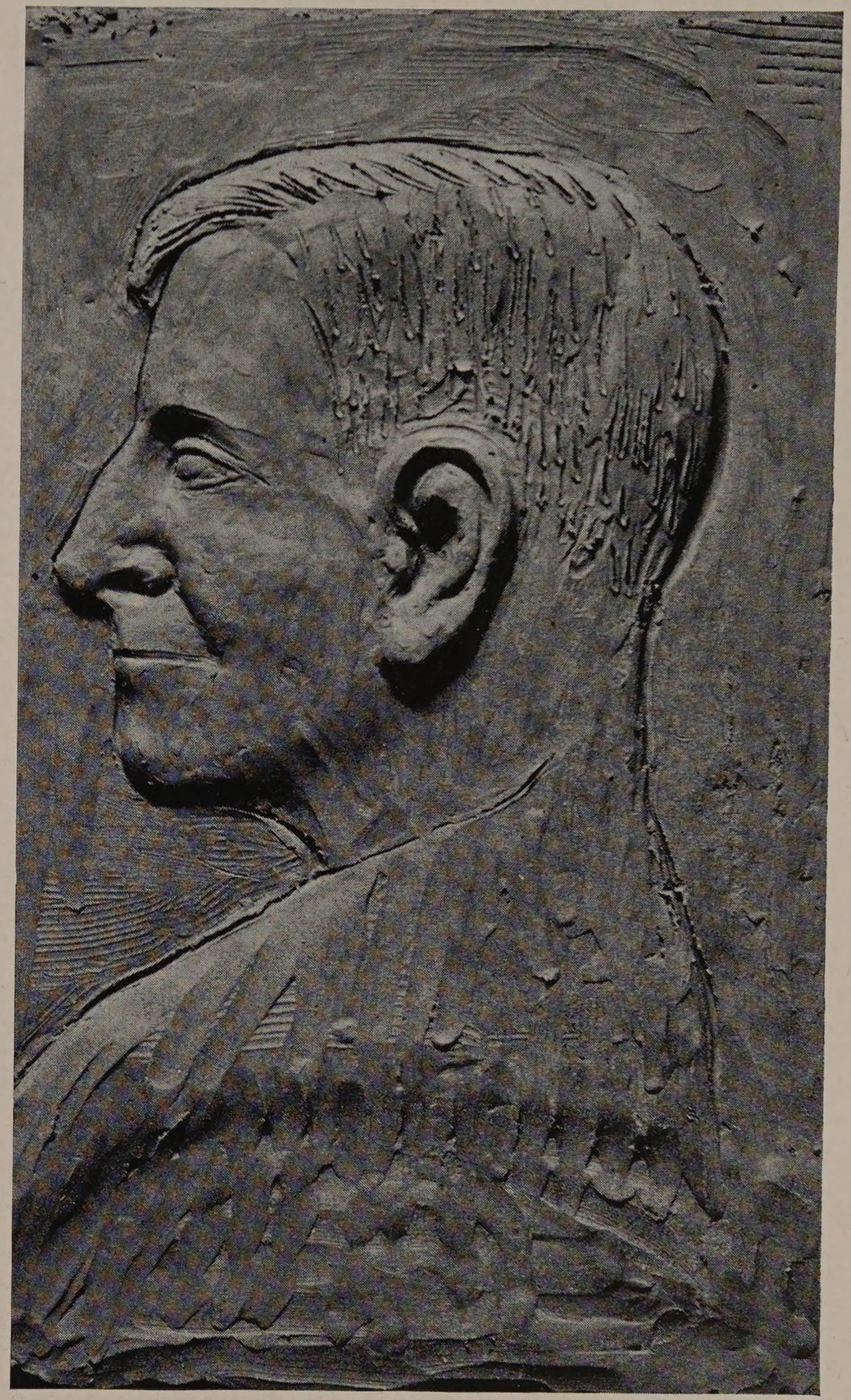
Now, if we wish to make a true bas-relief, we do not want it to look like half a head cleft down the center and stuck on the background, so we must reduce, or telescope, this thickness. By bringing our lines A, B, C, etc., closer together, we approach low relief in the only logical manner (Diagram 10). Here every part is still in its proper relation to the vertical lines: ear and shoulder still fall between A and B; head, cheek and neck lie between B and C; the eye and the outer corner of the mouth still lie between C and D; and the nose lies about halfway between D and E. Diagram 11 shows what happens when the vertical lines are brought still closer together. This diagram fairly represents the profile view of a true bas-relief.

The student who attempts a portrait relief without realizing the above rules soon flounders. The ear, being nearest to him, will look so important that he will model it almost in the round, and dig the orifice way through to the other side of the head. The shadow under the brow will cause him to set the inner corner of the eye so deep that he will have no room for the width of the nose. He may also make the entire edge of the profile as high as the center of the head, which, being nearer to him, should be definitely higher.



L.G.

PLATE 44. The Finished Relief



L.G.

PLATE 45. What *Not* to Do

He must learn to think of the head as a series of flat planes, gradually receding from the center out to the edge, or profile. If the entire "half head" is reduced to the thickness of ½ inch or less, the ear should be *wafer-thin,* if it is to be in correct proportion to the rest, and the various deep hollows in the living head must be no more than slight depressions on the flattened surface.

In Plate 42, notice the series of flat planes graduating from the shoulder to the front of the neck, which lies against the background. The bony part of the shoulder is a shade higher than the muscular part which sweeps upward toward the neck; set back in overlapping layers from this plane are the various neck forms, the one under the jaw being furthest from the sculptor's eye and consequently the lowest. Yet there is scarcely more than ⅛ inch difference in height between the shoulder and the center of the neck.

Plate 44 shows the relief nearer completion.

Plate 45 shows what happens when an untrained beginner attempts the same thing:

Mistakes: 1—The head is placed too near the left edge.
2—The central part of the head is concave where it should be convex.
3—The inner corner of the eye is dug in far too deep, allowing no width to the nose.
4—The nostril is set too deep, allowing no room for upper jaw bone.
5—The cheekbone is entirely missing.
6—The ear is too large, set too low and too far forward; set vertically instead of in a line with nose; it is modelled in the round; the hole penetrates to the background.
7—The direction of the mouth is wrong, and there is no suggestion of break in form between underlip and chin.
8—Neither the direction nor the form of the neck has been studied.
9—The hair has been scratched in with a lot of little sharp lines, with no sense either of its direction or of the form of the principal masses.
10—When the pupil came to the problem presented by the shoulders, he just "didn't know what to do,"—so he blurred his clay off into a meaningless smudge.

Unfortunately, Mistake 10 frequently persists, even after the student has corrected most of the others. Sometimes it is mere poor taste on his part, but more often it is a confession of inability to cope with the problem. Nothing so weakens a relief as this "trailing away" into the background. If you are going to make the shoulders, make

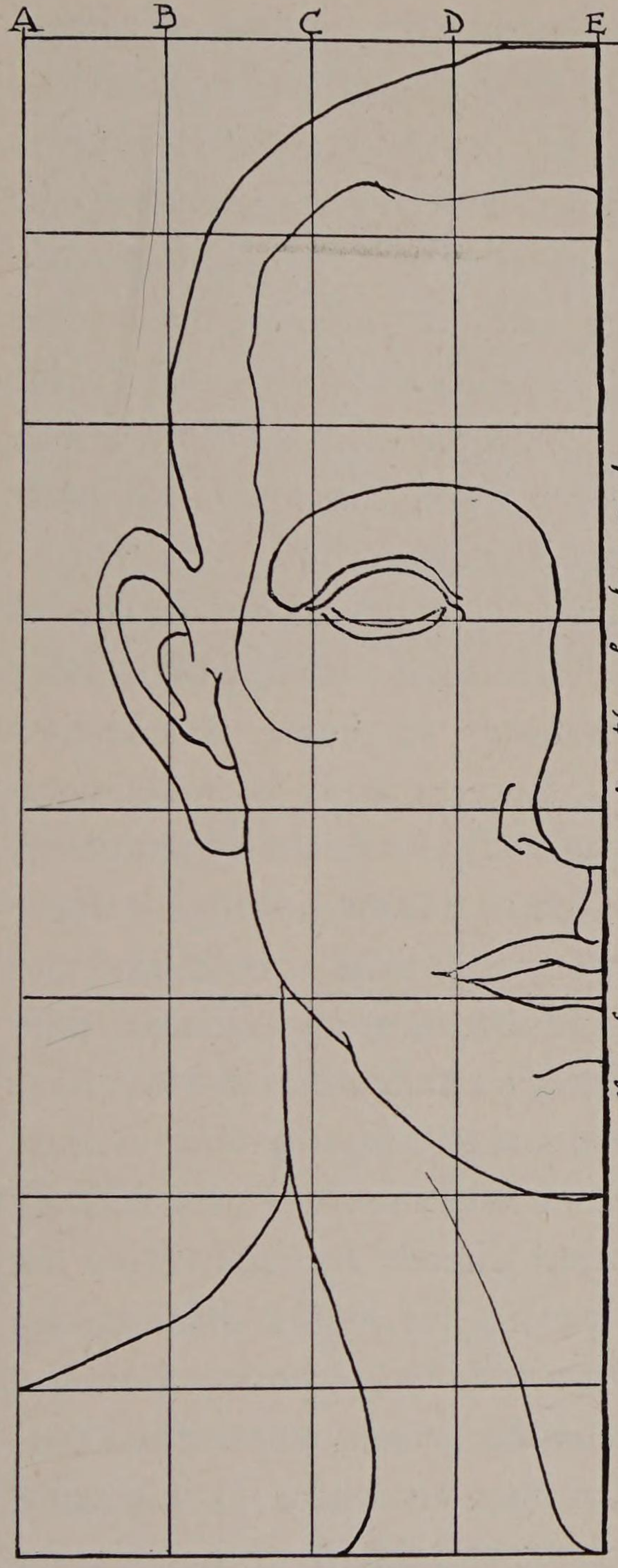


DIAGRAM 9

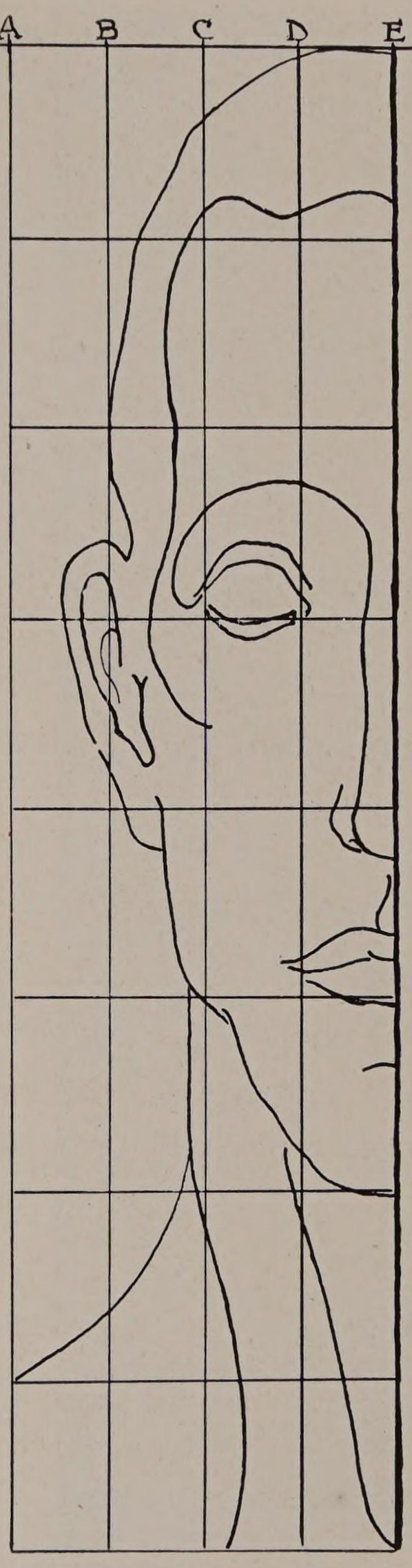


DIAGRAM 10

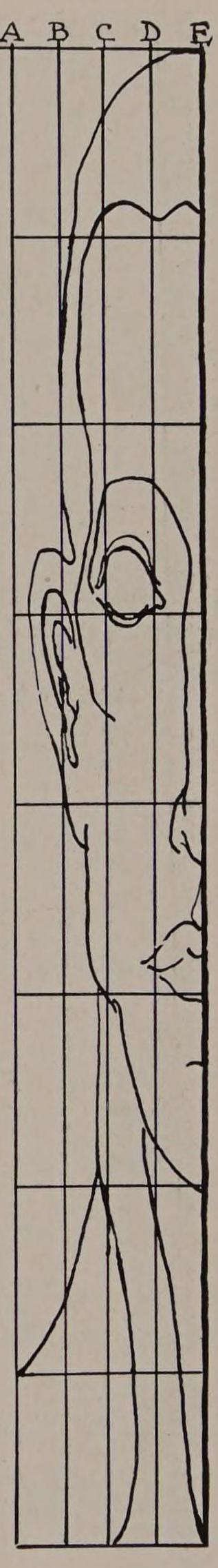
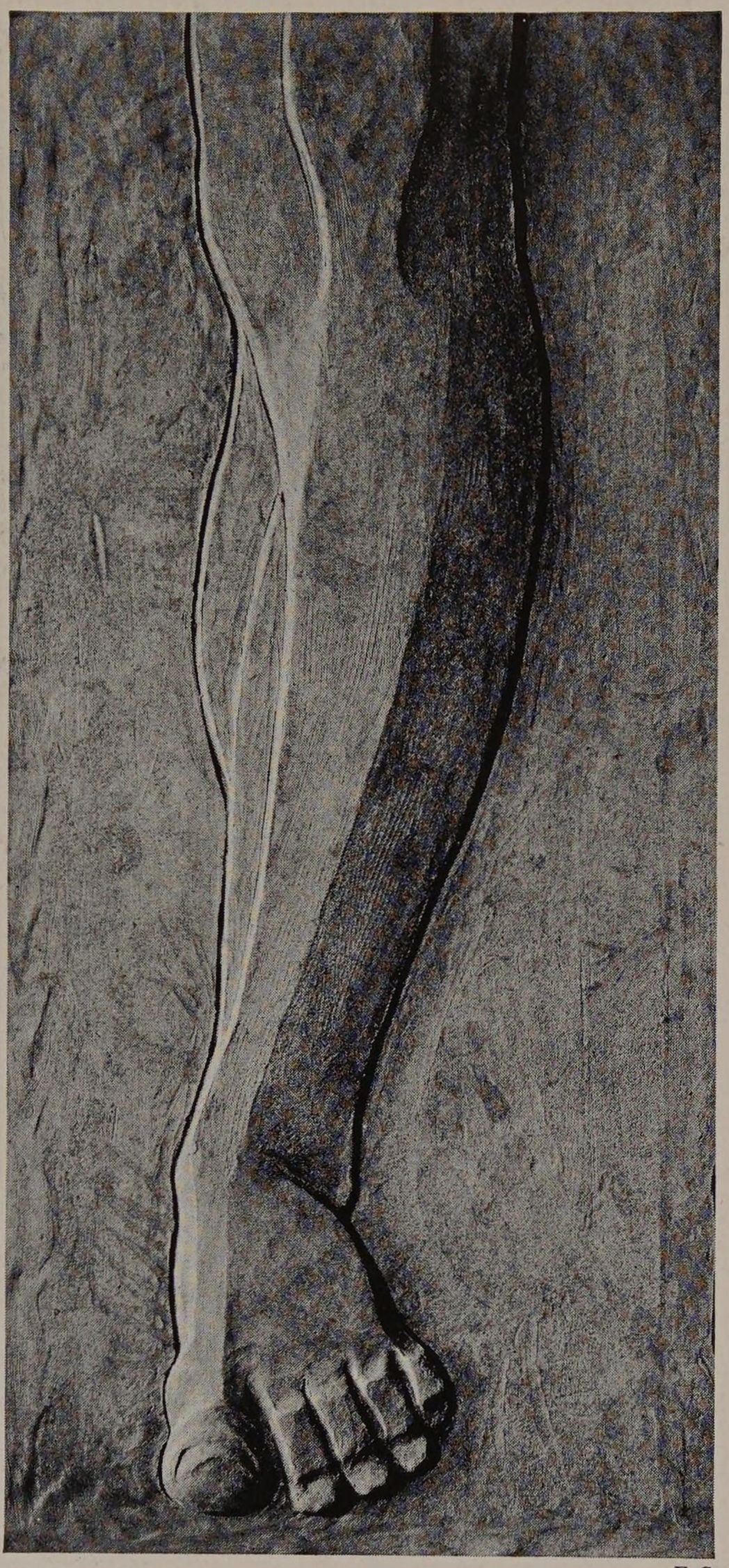


DIAGRAM 11

them. If not, cut them off clearly and definitely at the point where you feel you have said enough, as they did in the old Greek coins. In a rectangular relief you may, if you wish, build up the lower inch or two of your base into a sort of flat plinth, upon which the "bust" may rest. This space will be useful for lettering, should you wish to add the name of your sitter.



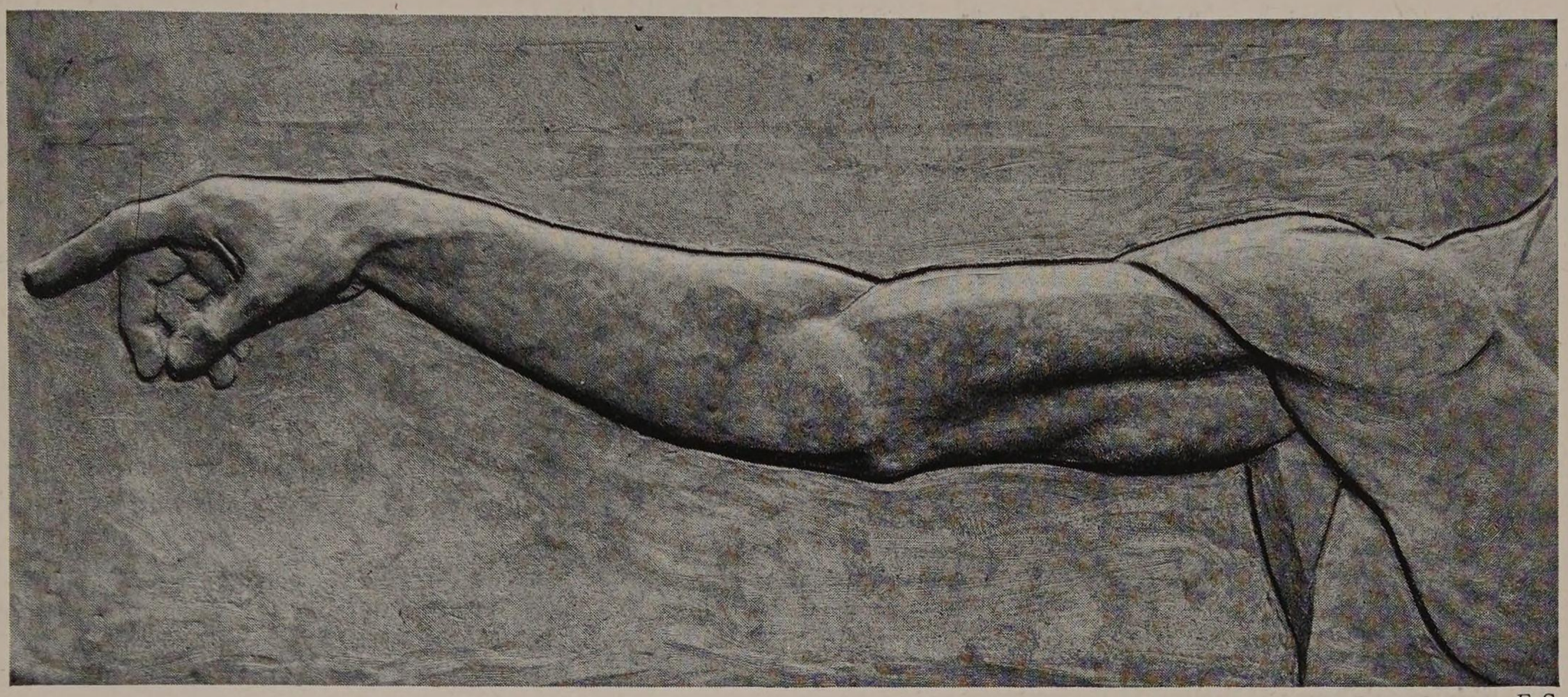
E.S.

PLATE 46. Study of Leg in Relief

An excellent practice for those who habitually make their projections too high and too round, but "can't seem to help it," is to do as follows: Holding your relief upside down, about two feet from the floor, drop it flat! This will hurt you more than it does the relief. It will serve to level down the high parts, but will not otherwise materially damage your work. The operation takes courage but is well worth it.

When whole figures in relief are attempted, the sculptor usually places them, as he does heads, in profile. A side-view foot, for instance, is ideal for relief treatment. Occasionally, however, the sculptor is obliged to model a front-view figure where he usually comes to grief at both head and feet. Granted that these are extremely difficult problems, we must admit that they have been solved and still may be. For instance, in Plate 46 we have a study of a leg with the foot pointing directly forward. Must not this foot project far higher than the leg itself? Not at all. Once the foreshortened foot is accurately *drawn,* we need build no higher there than elsewhere. In this study, knee, shinbone and the tip of the great toe are all of equal height. The foreshortening of the foot was indicated first at the ankle, where the plane of the instep overlaps the outer anklebone; then at the great toe where two or three carefully studied planes, combined with a foreshortened indication of the nail, suffice to give the effect of projection. Note, too, how the inner calf muscles are set back in planes from the shin which lies in front of them.

Architectural reliefs, such as are used to ornament the outer walls of buildings,



E.S.

PLATE 47. Study of Arm in Relief

seem rather advanced problems for the untrained student to tackle. But that he does tackle them is proved by the hundreds of models submitted in each new nation-wide competition for such work. And once in a blue moon the tyro's design does win out over those of professionals; so a word or two on the subject may not come amiss here.

Generally speaking, present-day architecture demands one or the other of two totally dissimilar types of relief. One is the extremely flat-surfaced relief which projects hardly at all from the wall. For such panels or friezes, the wise sculptor does not model at all. He makes a slab of plaster, comparable to the masonry of the building on which his panel is to be carved. After drawing his design on this slab, he proceeds to cut away the background (much as in the demonstration, Plate 42). This accentuates the architectural and stony quality of his design, and of course automatically levels all the upper surfaces.

Working thus, the sculptor finds that what counts most (when he scans his relief from a distance) is the entire light-and-shade pattern formed by the figures and the spaces between the figures. What counts *least* is the details: expressions on the faces, scattered bits of hair or drapery, etc. For, placed high on the building itself, such details will not carry to the beholder. All that will really matter will be the pattern itself.

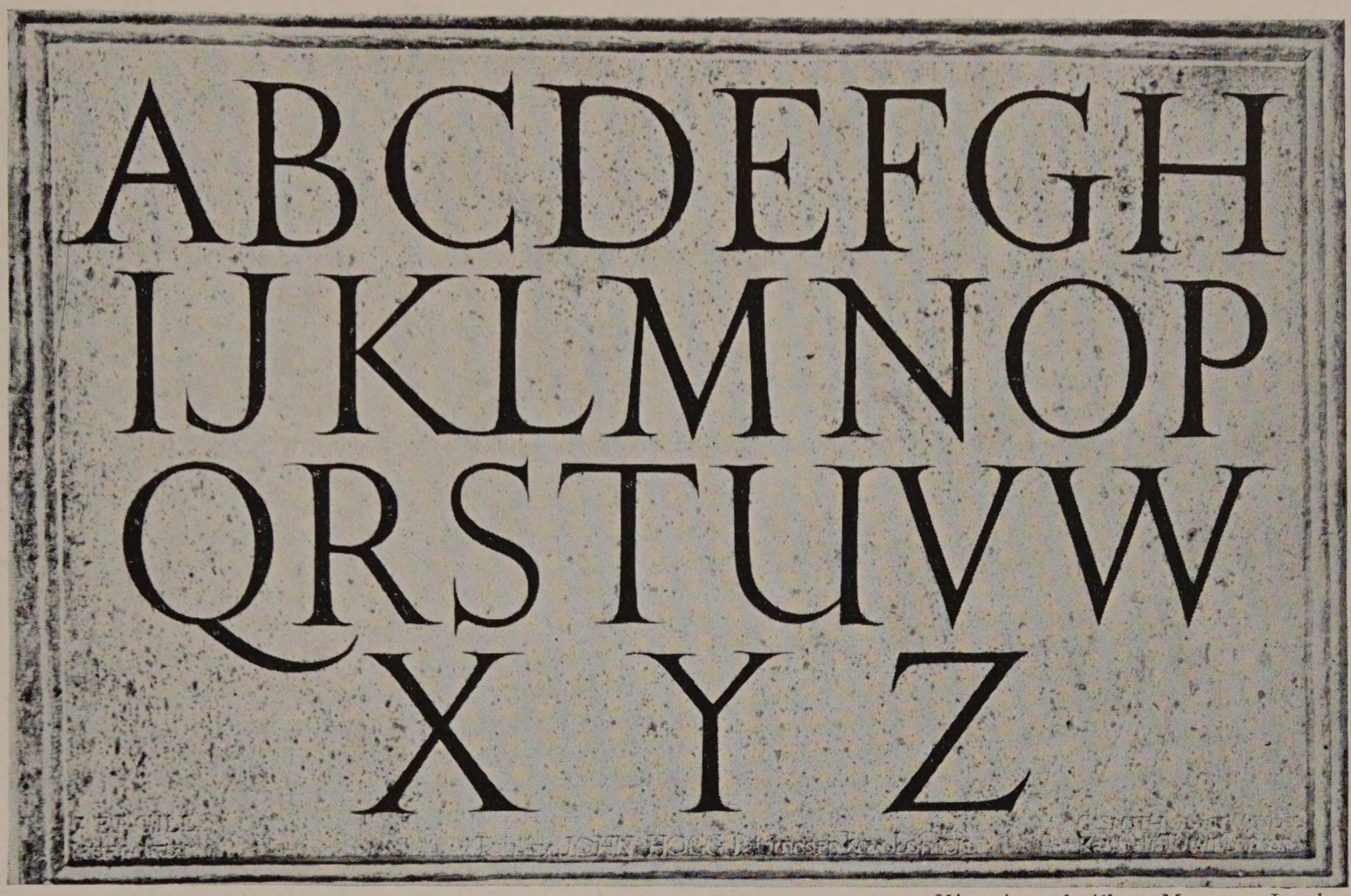
A very different type of embellishment for today's blank-walled architecture is a single spot—or *clump*—of sculpture in extra-high relief, apparently thrown at the wall and magically stuck there. It has no visible support, no corbel, no enclosing frame

or niche, no *raison d'être,* indeed, except to give a sudden note of color to an otherwise barren expanse of wall. Properly handled and judiciously placed, such isolated excrescences can be strikingly effective; but too often they are merely thick, clumsy lumps of matter, entirely out of scale and harmony with the building itself. And if such top-heavy masses are installed directly above a normal-sized entrance to a building, the psychological effect on the humble pedestrian is most unfortunate. "Heavy, heavy hangs over thy head," he probably mutters to himself, as he dodges warily in and out under that beetling crag of stone!

LETTERING

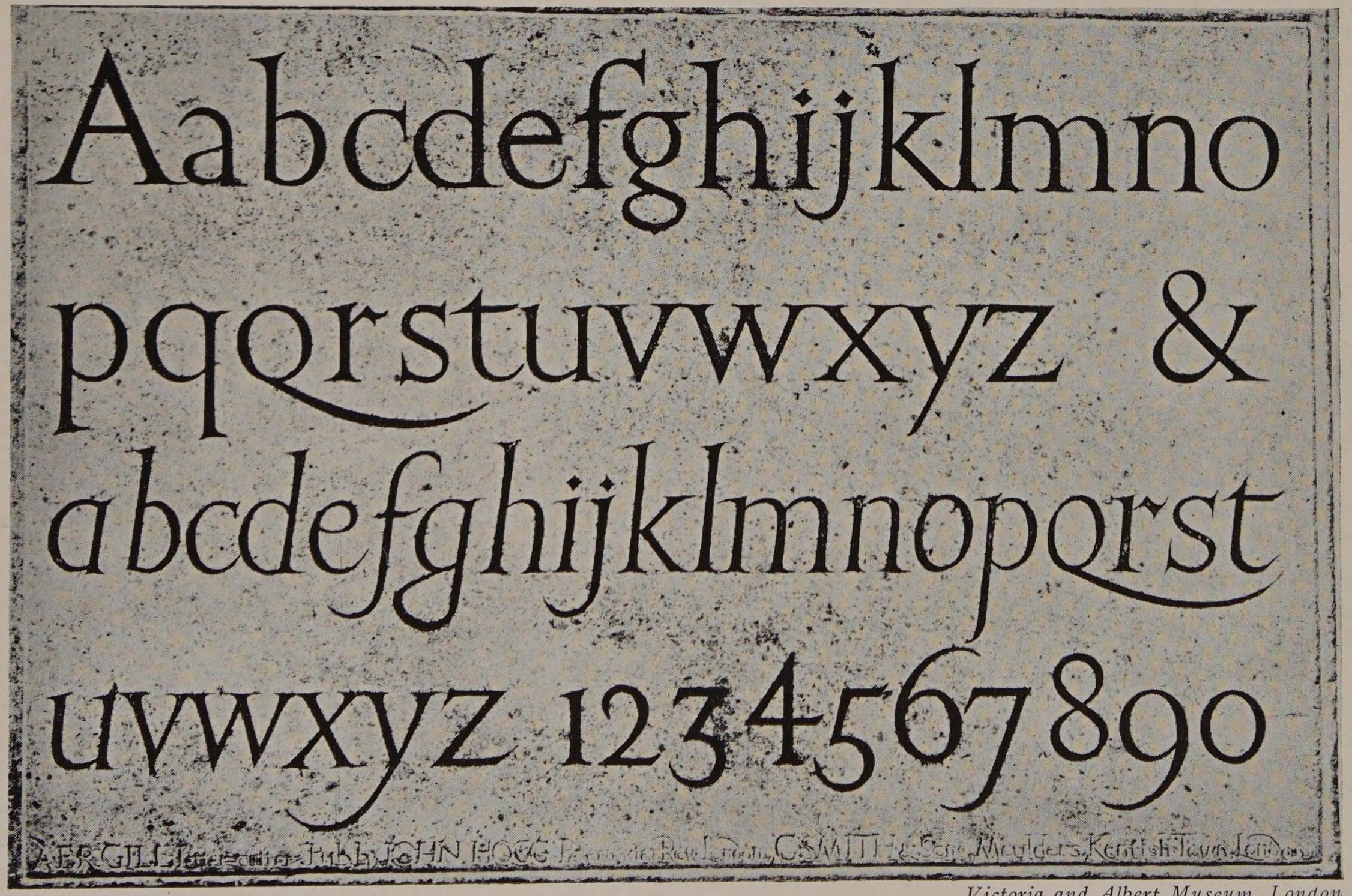
Many a good relief has been ruined by badly designed lettering, and many a poor one has been redeemed by well-chosen letters, carefully spaced to make a decorative pattern. A sculptor should make a special study of lettering, both raised and incised, from the ever-satisfying Roman through all the varying types. The illustrations in Plates 48, 49 and 50, should be of particular interest to the student, for they were designed by Eric Gill, the British sculptor, whose masterly handling of inscriptions is justly praised, especially by architects. Plate 49 is particularly helpful, as it gives Arabic numerals, today much more frequently used than the cumbersome old Roman combinations which are hard for the layman to decipher. The third plate—an inscription painted on wood—is a quaint combination of Roman capitals and "cursive script." Note how delightfully the artist has tucked the unimportant little Es inside the fat D and C, thereby enhancing his design, as well as saving space. A sculptor will more than once be called upon to design a plaque or tablet in which the inscription is the sole ornament. A thorough understanding of the basic construction of good letters is as much a part of his technical equipment as an understanding of relief itself.

Generally speaking, raised letters are best for bronze, and incised letters for stone. Of the hundreds of different types of lettering which may be found in the many useful books on the subject, many must be discarded as being unsuitable for sculpture, or at least for the type of sculpture one is doing. A very heavy, bold letter may be appropriate for the outside of a building, or for an impressive sepulchral monument, yet entirely out of scale for a delicate medallion of a child's head. Irregularly spaced and informal lettering can be very charming in its place, but will hardly do for a formally classic monument. At times, however, such naïve irregularity has a delightfully decorative quality, as in the 12th century inscription on one



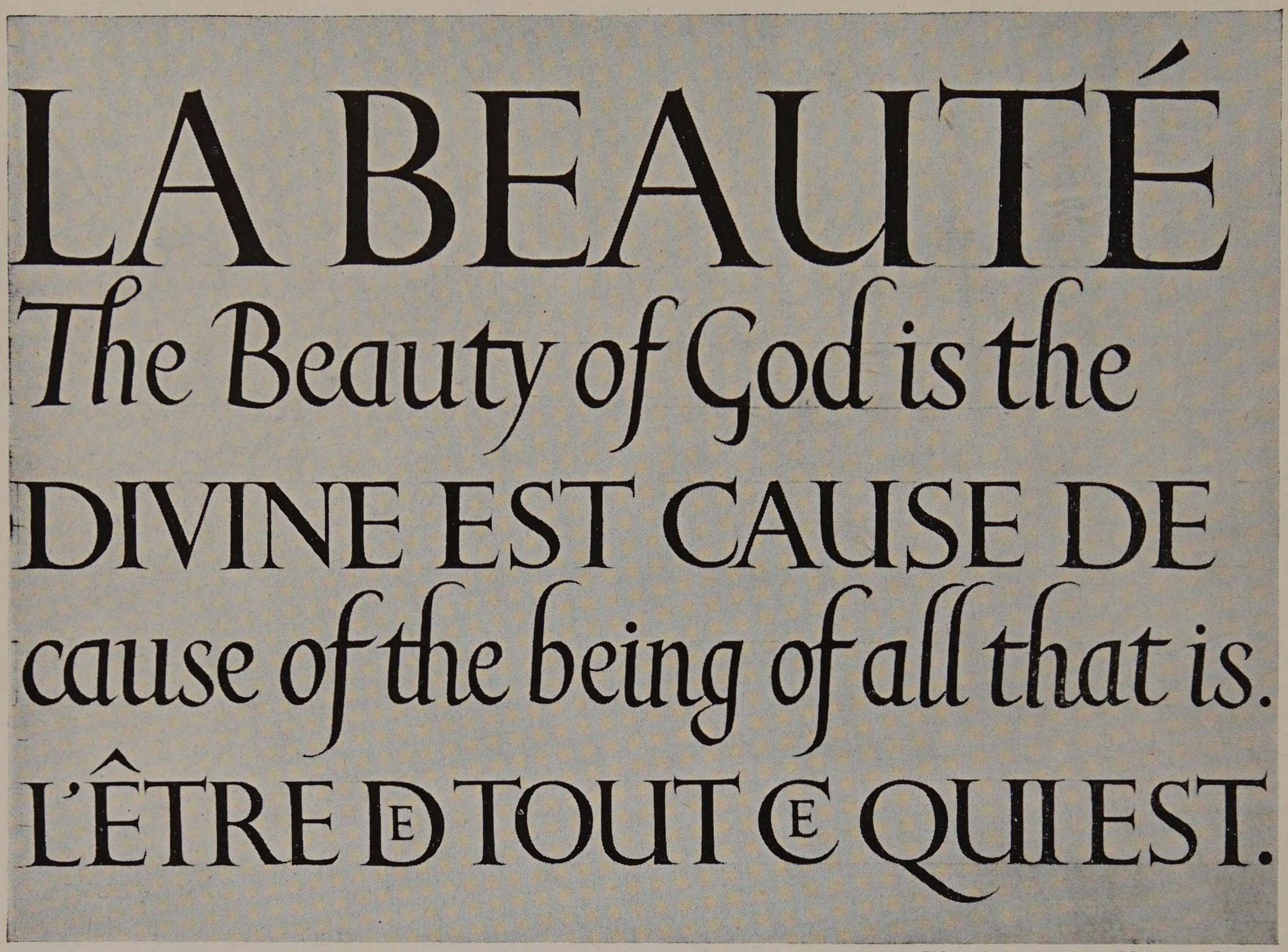
Victoria and Albert Museum, London

PLATE 48. Roman Lettering, *Incised in Stone*. Eric Gill



Victoria and Albert Museum, London

PLATE 49. Panel of Lettering, *Incised in Stone*. Eric Gill



Victoria and Albert Museum, London

PLATE 50. Panel of Lettering, *Painted on Wood*. Eric Gill

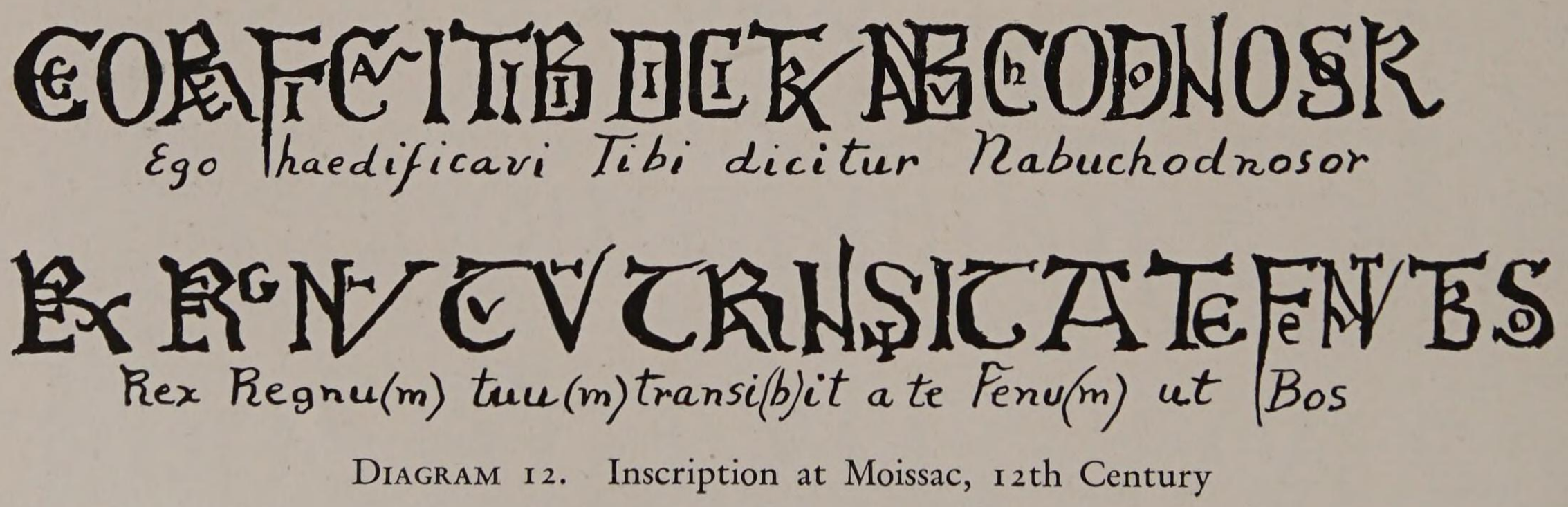


DIAGRAM 12. Inscription at Moissac, 12th Century

of the capitals at Moissac. (Diagram 12 is freely and possibly somewhat inaccurately rendered from a notebook sketch.)

As a specific example of how we go about making an inscription on a small plaque, let us assume that you wish to make the lettering form a border for a round medallion. You have made a little portrait of Jane Doe on her twelfth birthday. How, except by guessing, can you calculate where each letter should come, if they all are to be spaced properly around the edge? On a piece of paper, print out the inscription. Count each letter, allowing a count for every space between words. In "Jane Doe on Her Twelfth Birthday" we have a total of 32, so 16-17 will come in the top center of the plaque. 16 is a space, and 17 is the first T of "twelfth." Starting at the top with this T, lightly scratch in the last half of the inscription around the right-hand side of the relief. Now, working backward from the center, draw in the first half (Plate 51). Occasionally one has to use a word in which several Ws, Ms, or other wide letters occur, while another word will contain several thin Is. This will throw our spacing a little off balance and our calculations must be adjusted accordingly. With a double O, it is frequently admissible to interlock the two Os to save space; and when such letters as L and T come together, one can crowd them a bit by letting the horizontal of the L slip in under the left horizontal of the T.

There are two ways of making raised letters. One can model them by laboriously rolling little "worms" of clay, laying them on our scratched-in letters and working over them until they are the proper shape and height. This is, however, a heartbreakingly tedious and inefficient way of working; and, with few exceptions, sculptors prefer a different method. When the plaque has reached the stage shown in Plate 51, the sculptor makes a mold, or impression, of it in plaster. This plaster mold shows everything in reverse: the raised head is now hollow, incised, as it were, like an intaglio; the head faces the opposite way and the faintly traced inscription reads backward. The sculptor now takes a small tool with a rounded end and carves or incises his letters in the moist, but firm, plaster mold (Plate 52). When a cast is taken from this mold, the lettering shows in relief and the thing is done (Plate 52a). By using the one tool to carve all the letters, one achieves a uniformity of width and depth that is practically impossible in modelling. Plates 52 and 52a show both the cast and the mold with the inscription cut in. The lettering used here is of the simplest kind, not at all interesting or particularly decorative, but for that very reason a good type to use in one's first experiments.



E.S.

PLATE 51. Relief with Inscription Scratched In



F.E.W.

PLATE 52. Mold of Relief, with Letters Incised



F.E.W.

PLATE 52a. Cast of Relief, with Letters Raised

CASTING A PLAQUE

The difficult and messy job of casting clay models in plaster is one which in most cases is done by an expert caster, not by the sculptor himself. To make a good cast of a complicated piece of sculpture requires long practice and is a hazardous undertaking for the student, who usually ruins both clay model and plaster cast before he is through with it. But simple casting of small bas-reliefs is something every student should know how to do and, as has been pointed out in the last paragraph, is an absolute necessity for those who undertake portrait reliefs, medals, or coins.

Unless clay can be fired in a kiln, it will crumble in no time, while plasteline remains so soft it may easily be damaged. So our models must be translated into a more durable material if they are to be handled, exhibited or shipped to a distance.

Let us suppose that you have made a little portrait similar to the one in Plate 51. The materials which you will need are as follows:

Five to ten pounds of the finest casting plaster
Some liquid blueing
A quart-size mixing bowl
An old tablespoon
A couple of spatulas
A small hammer
A thin-edged chisel
Shampooing liquid

I have found that shampooing liquid is preferable to the soap which professional casters use. It costs more, but you will use only a small amount.

As even a small quantity of spilled plaster can make an unbelievable mess if it is stepped on and tracked about the house, it is best to cover both your stand and the floor about it with newspapers. Now take some clay, roll it out on a board and cut into strips about twice as wide as your plaque is thick. Lay these strips edgewise all around your plaque, forming a wall to keep the liquid plaster from running off the relief onto the board. This wall should be about half an inch higher than the highest part of your relief. Pour into the mixing bowl enough water to fill the ring of clay. Add a teaspoon of blueing to the water. Now take a handful of plaster and, holding it close over the water in the bowl, sift it into the water, feeling with your fingers and discarding any little lumps or impurities in the plaster. Now another handful, and another, until the plaster is level with the water. This is known as "gauging"

the plaster, which must be of the proper consistency. If it is too thin, it will never set hard, but remain cheesy; if too thick, it will not take a clear impression of your work and will "set" or harden too rapidly. This gauging must be quickly done and with no interruption, for the moment plaster touches water it begins to set.

Now slip your spoon quietly to the bottom of the bowl and stir the mixture quickly and thoroughly, trying not to get air bubbles in it. It should now be of the consistency of cream and of the palest blue in color. Take a spoonful and pour a small quantity over your plaque; jiggle the board, and tip this way and that so that the plaster spreads over the surface of the clay. *Blow* the plaster into every little hole and crack, or ease it in with a very soft brush, to eliminate any air holes.* Now with some more plaster, repeat the blowing and tipping, until the whole surface is covered to the top of the clay wall. Rap the board quite sharply on the stand once or twice, to force to the surface any possible air bubbles. Then allow to stand and harden for at least an hour. Any plaster left over in the bowl should be thrown away, and bowl and spoon washed clean. Now test the plaster with your finger. If the plaster is dented or smeared by your touch, it has not yet "set"; but if it feels firm and slightly warm, you may be sure it is hardening properly.

The first step in taking off the mold is to remove the clay wall. Clean it of all drops of plaster before throwing back in your clay bin. If your plaque is in true low-relief, with no undercutting, the mold should lift off quite easily and your clay be left unharmed. Now rinse all flecks of clay from your mold with clean water and a soft brush. Remember that the plaster is still fairly soft and use the brush lightly, so as not to blur the modelling. If an inscription has been faintly traced on your clay model, now is the time to incise the lettering in the mold. For flat letters use a tool with a square wire loop or wooden end; for rounded letters use one with a rounded end. Remember that the deeper you incise the lettering, the higher it will be in the final cast. Be sure that you make no undercutting in your mold, or it will stick to the cast later.

Now let your mold dry, then paint with a coat of white shellac, thinned somewhat with alcohol.

When this is dry, pour a spoonful of shampoo liquid soap into the hollow of the mold and, with a soft, clean brush, work it all over the surface. It should lather as you do so. Allow the mold to stand half an hour in order to permit the soap to

*Wash the brush immediately, so that the plaster will not ruin it.



PLATE 53. Reliefs. Wheeler Williams

permeate every tiny pore in the plaster. Once the plaster is thoroughly soaped it will have a slippery surface to which no fresh plaster will adhere. Now, with the same soft brush, remove every trace of the soap that has not been absorbed by the mold. Do not use water, but pick the soap up on the brush and squeeze it into a slop bucket. Never try to use this soap again. Every trace of soap must be removed from the mold,



Courtesy Medallic Art Company

PLATE 54. Medal, *Bronze*. Lee Lawrie

or it will leave a scummy film on the surface of your cast. The mold should now feel clean and slippery but, if you wish, you may give it a final film of grease by brushing lightly with sterine. (Consult the formula on page 272.) Lay it down now and rebuild the clay wall around it, as you did around the clay relief. Make this wall as high above the mold as you wish your cast to be thick. Before mixing your plaster, take a small piece of copper wire and twist it into a loop, leaving the ends long and spread out sideways. Later, while the plaster cast is setting, this wire may be gently imbedded in the back of the cast, leaving only the loop exposed—a convenience in hanging it up on the wall later on.

Now mix your plaster as before, but without the blueing. As before, pour in a little at a time, blowing and painting it all over the surface and removing every air-bubble that appears. Fill to the top of the clay wall. Allow to set as before. After the clay wall is peeled off, you will easily see the line of demarcation between the blue mold and the white cast. Gently insert the thin blade of the spatula into this seam. If there was no undercutting and if the mold was properly soaped, the two should separate without difficulty, and your mold may be washed, soaped and used over again, should you wish to make more than one cast of your plaque.

If there are air holes or nicks in your cast, fill them up with a little fresh plaster immediately, while the plaster is still damp. If you find the lettering is too high, wait a day or two, until your cast is thoroughly dry, then rub the lettering down with fine



PLATE 55. "Saint Francis and the Birds," *Clay*. Libero Andreotti

sandpaper. Directions for tinting plaster casts will be found at the end of the chapter on portrait busts.

For a panel of incised lettering in which no modelling is involved, the best procedure is as follows:

On a sheet of tracing paper, mark off the exact size of the panel; on this paper draw the inscription exactly as you wish it to appear in the finished panel; cast a thin slab of plaster the size of the panel, reinforcing it across the back with a few thin iron bars. Now pin the tracing paper on the panel with thumbtacks and prick



PLATE 56. "The Raising of Jairus' Daughter," *Stone*. Julian Phelps Allan

the outlines of the letters through onto the plaster. For this, a darning needle set in a cork is as handy as anything.

Remove the paper and, with a sharp tool, lightly outline the letters along the needle pricks. Now begin carving your letters in the plaster, keeping this wet by frequently splashing with water, as dry plaster is brittle and hard to cut.

Roman letters should, of course, always be incised with a V-shaped groove. Block letters may be cut U-shaped with a round-end tool.

Before closing this chapter, I want to show you a few reliefs made by contemporary sculptors.

The gaily pagan reliefs of Wheeler Williams (Plate 53) are charming and

extraordinarily clever little designs, which were not modelled at all, but carved in reverse in a slab of plaster (as the ancients so often carved their gems) and then cast from that plaster mold. Note how each design so satisfyingly fills its allotted space. Even in "Diana," where the upper left-hand corner might otherwise have been a bit empty, the star nicely completes the composition.

Very different in spirit is the medal by Lee Lawrie (Plate 54). I think it the most beautiful medal that has been made in this country; especially the exquisitely simple "reverse," which is a masterpiece of design and spacing, and in which the idea is expressed with such quiet power and restraint. It affords a fine contrast to the vigorous sower, with his wide-flung right arm and sturdy forward movement. The reverse of this medal suggests Lawrie's equally simple and telling interpretation of Isaiah II : 4, "And they shall beat their swords into plowshares" (International Building at Rockefeller Center, N. Y.); a clear case of sermons in stone.

Two more such sermons are the ruggedly treated yet infinitely tender "St. Francis and the Birds" by Libero Andreotti, and the noble "Raising of Jairus' Daughter" by Julian Allan (Plates 55 and 56). The latter (who, by the way, is a woman) was a pupil of Andreotti and also of Eric Gill, who designed the beautiful letterings in Plates 48, 49 and 50. To master and to pupil alike, art and religion are practically synonymous. They *live* and *work* their religion with an ascetic devotion and intensity which inevitably permeate all their creative work. Just such a spirit motivated the great unknown artists of the early Gothic period.



PLATE 57. Congressional Medal awarded to Fleet Admiral Ernest Joseph King. Brenda Putnam

CHAPTER V

AN OUTLINE OF HUMAN ANATOMY

INTRODUCTION

IN Chapter I, we turned for our analysis of simple forms to the science of mathematics. Balls, cubes, cylinders, etc., in various combinations, proved to be the underlying structural units of all objects.

In this chapter, concerned with the underlying structure of the human body, we turn for information first of all to the science of anthropology, in order to get some sort of mental picture of man's development.

The limitations of this book prevent any thorough study of the scientific miracle of man's evolution but, described as briefly as possible, the theory is this:

All life originated in the sea. From the single cell of the amoeba, through the jellyfish and other barely sentient creatures, we trace the development of the true fishes.

A certain prehistoric shark was the prototype of the creatures which eventually emerged from the sea. Diagram 13 shows us this shark. His bony framework, or skeleton, consists mainly of skull and spine. But at the roots of his lateral fins there are bony processes which will, as his successors crawl out of the water, become rudimentary shoulders and hips.

The lobe-finned fish (Diagram 14) is using his fins as arms and legs to crawl up onto the mudbanks. He cannot crawl very far with these stumpy pads, but they are the beginning of better things. So far, his head and "shoulders" are joined together. He has no neck and his belly drags on the ground. I do not know how many eons it took to complete the transformation, but eventually, from this clumsy amphibian, evolved the lizard.

Diagram 15 shows us the lizard. Here we note a marked advance. The creature's head and shoulders are separated by a flexible neck. His arms and legs are hinged, or jointed, so that he can lift himself off the ground and really walk. He has a

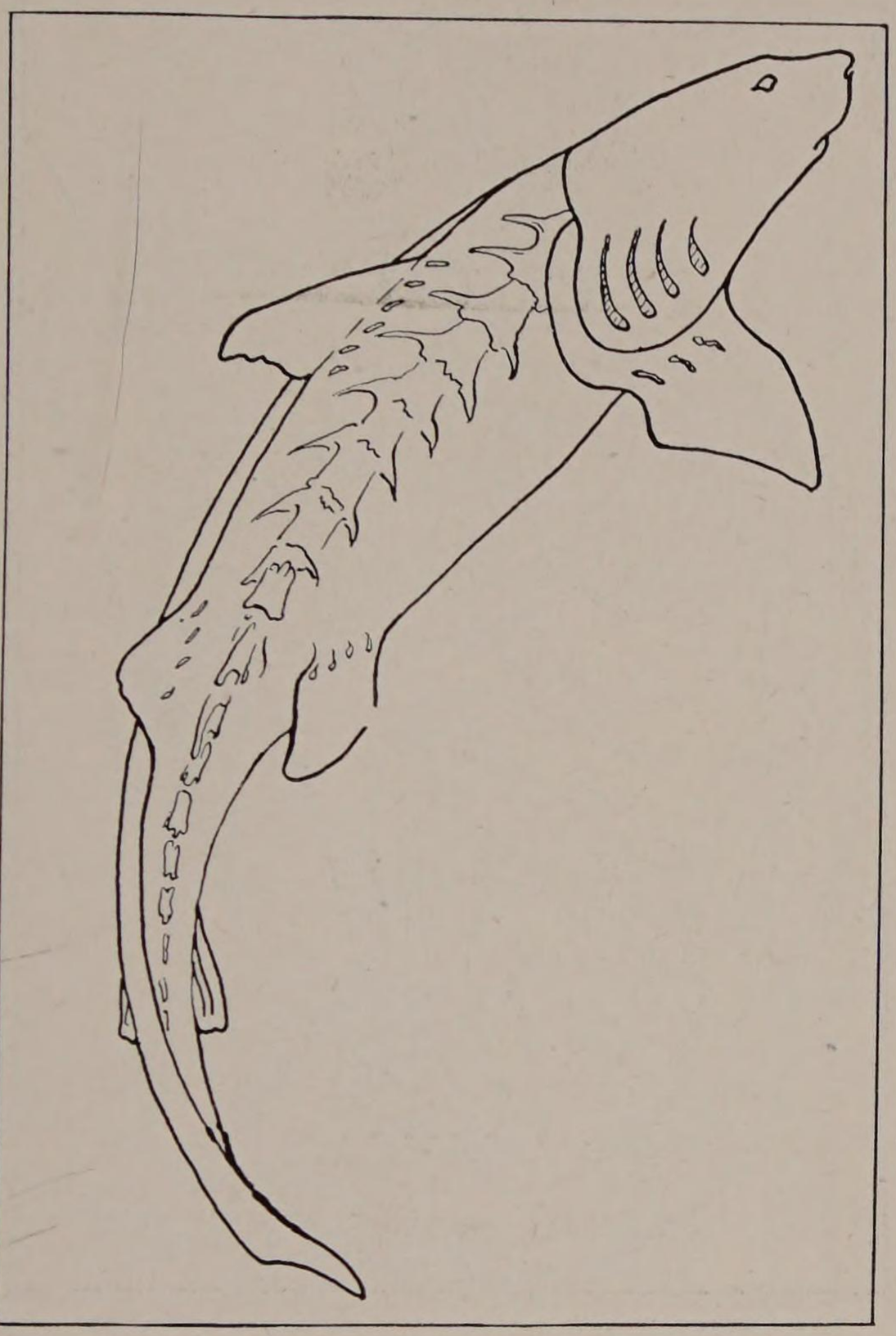


DIAGRAM 13

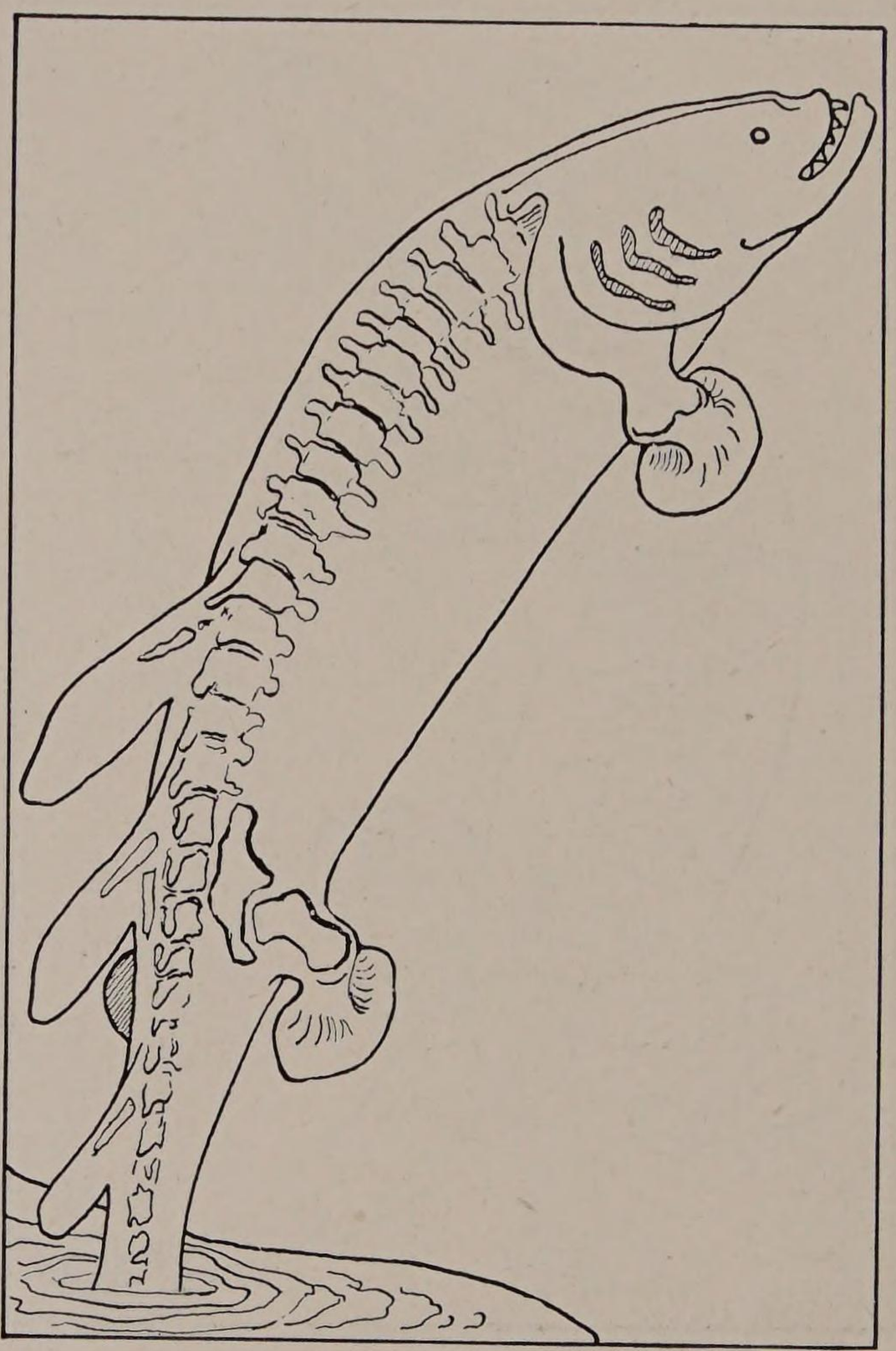


DIAGRAM 14

"shoulder girdle" and a "pelvic girdle." His fingers and toes are still webbed, for he has not yet altogether forsaken his first home—the sea—but he breathes through his nose, instead of through gills, and will soon develop a "rib basket," in which to encase his lungs. At present his short arms and legs still sprawl sideways and he can only crawl. The sooner they grow under him, the sooner he will be able to run.

During the eons which followed, the descendants of the lizard branched off into many varied species. Some grew in size, rather than in intelligence, becoming dinosaurs and other such monsters; some took to the air and eventually became birds. Some took to the trees, and it is one of these which we now study. He came into existence somewhat over fifty million years ago. He remained quite small, but became very nimble, with long slender arms and legs and a prehensile tail. We call him a lemur (Diagram 16).

Skeletons of lemurs of this kind have recently been dug up in Montana. The

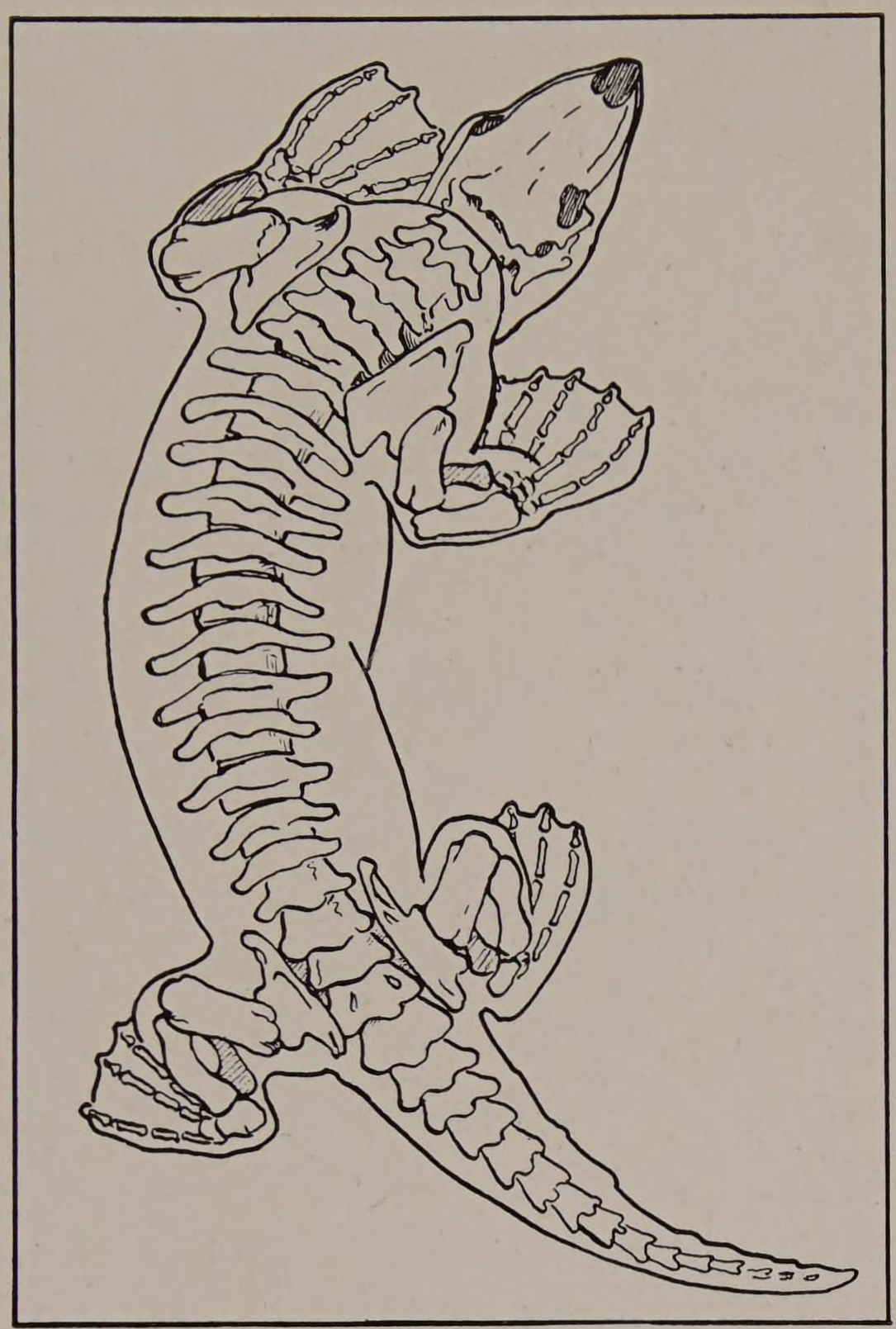


DIAGRAM 15

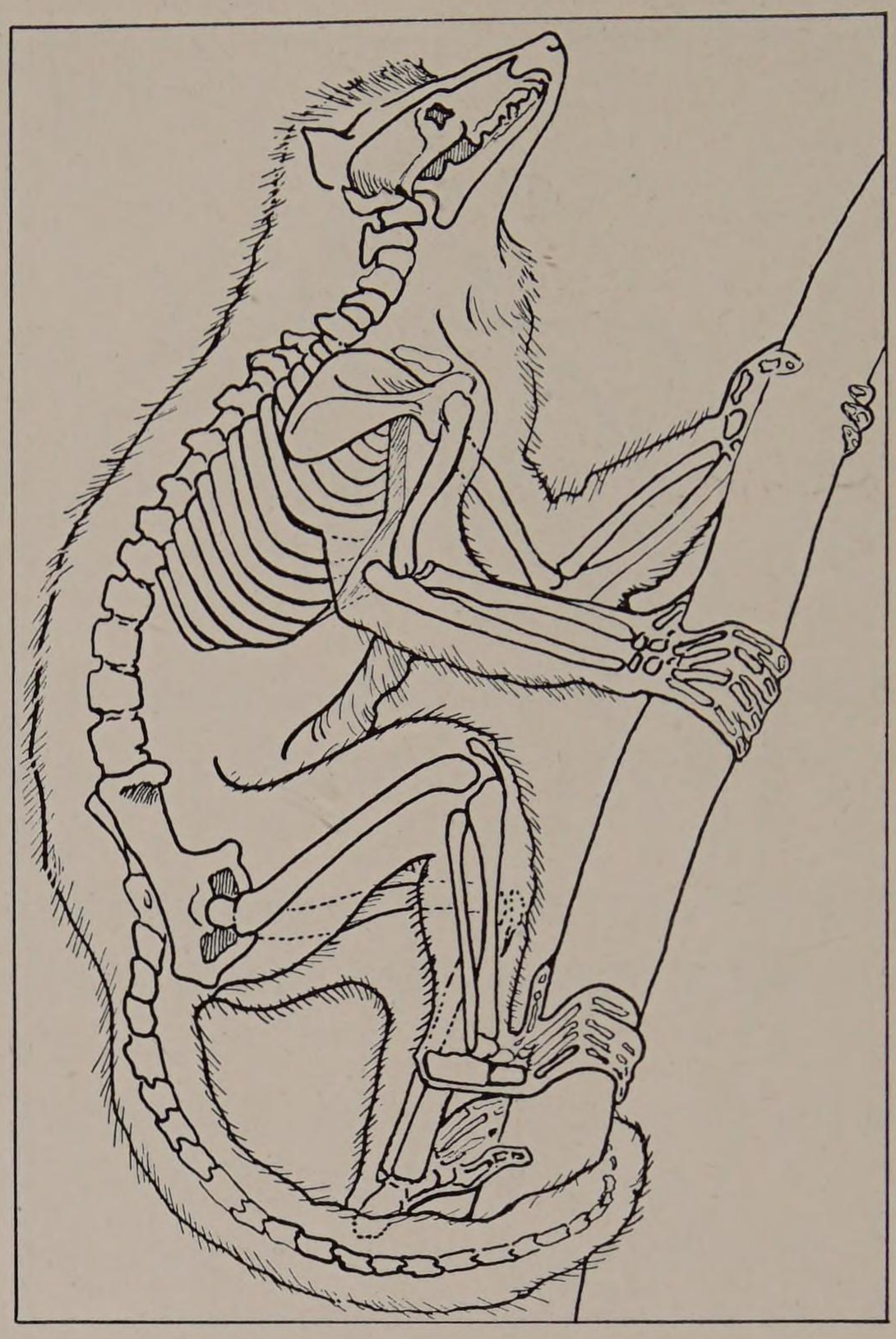


DIAGRAM 16

lemur still exists today, though now his sole habitat is Madagascar. Our common opossum also lived at this period, so both he and the lemur might be called "living fossils." In the lemur, we have the first skeleton which bears a close resemblance to man's. If you compare his bones with those of the man in Diagram 18, you will note a quite startling similarity. See how his hands grasp the branch; how like is his little shoulder blade to ours. The main differences lie in the shape of the skull and the haunchbone (pelvis) and in the fact that the lemur has a tail.

Gradually, as a new and more intelligent creature evolves from this little beast, we note a rounding of the skull to accommodate the increasing brain; a shortening of the muzzle; the elimination of the tail; and the widened chest caused by the using of the arms for lateral movement as, with the ape, our forebears descend once more to the ground and begin to walk upright (Diagram 17).

No scientist claims that man is descended from any species of ape now living.

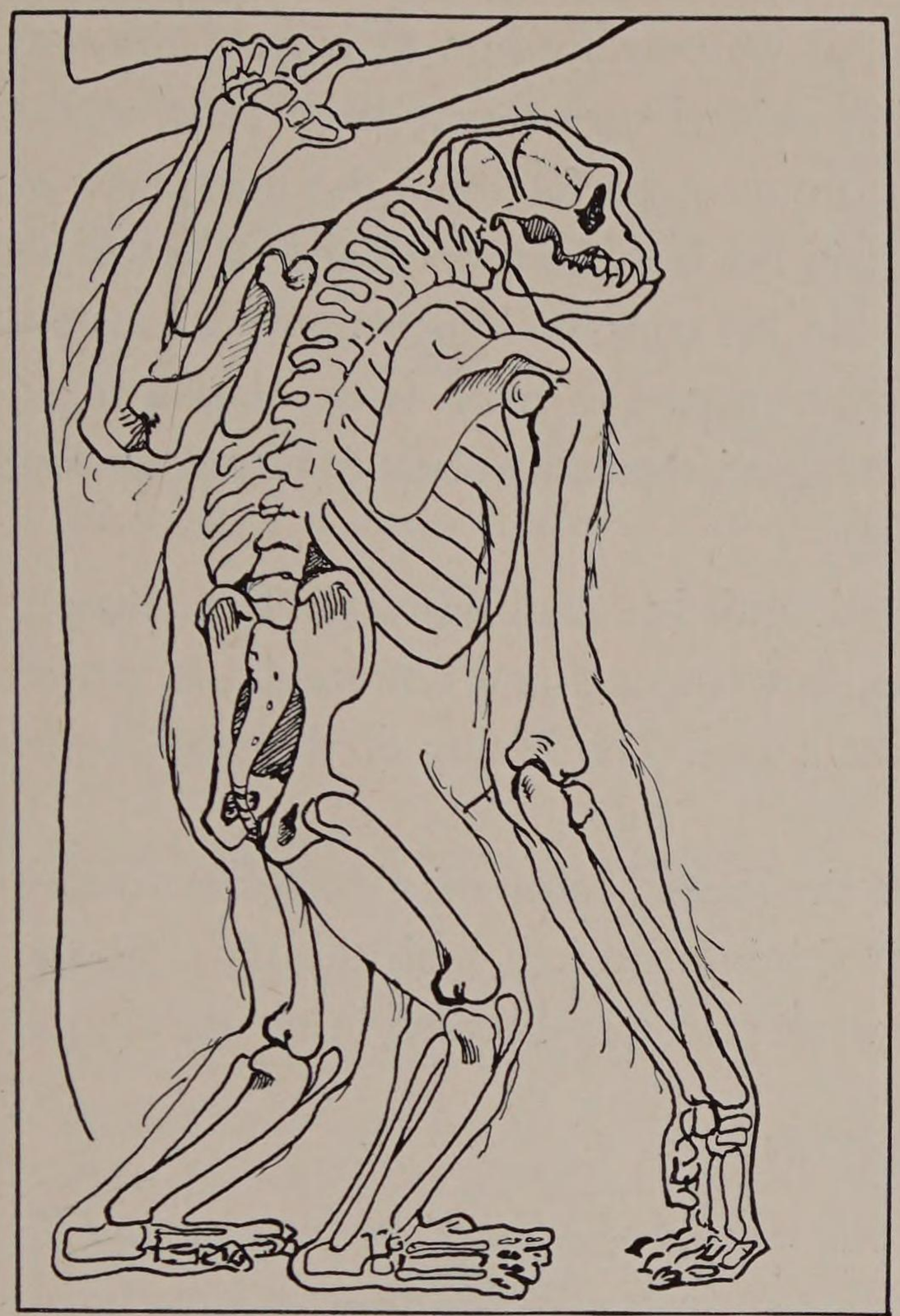


DIAGRAM 17

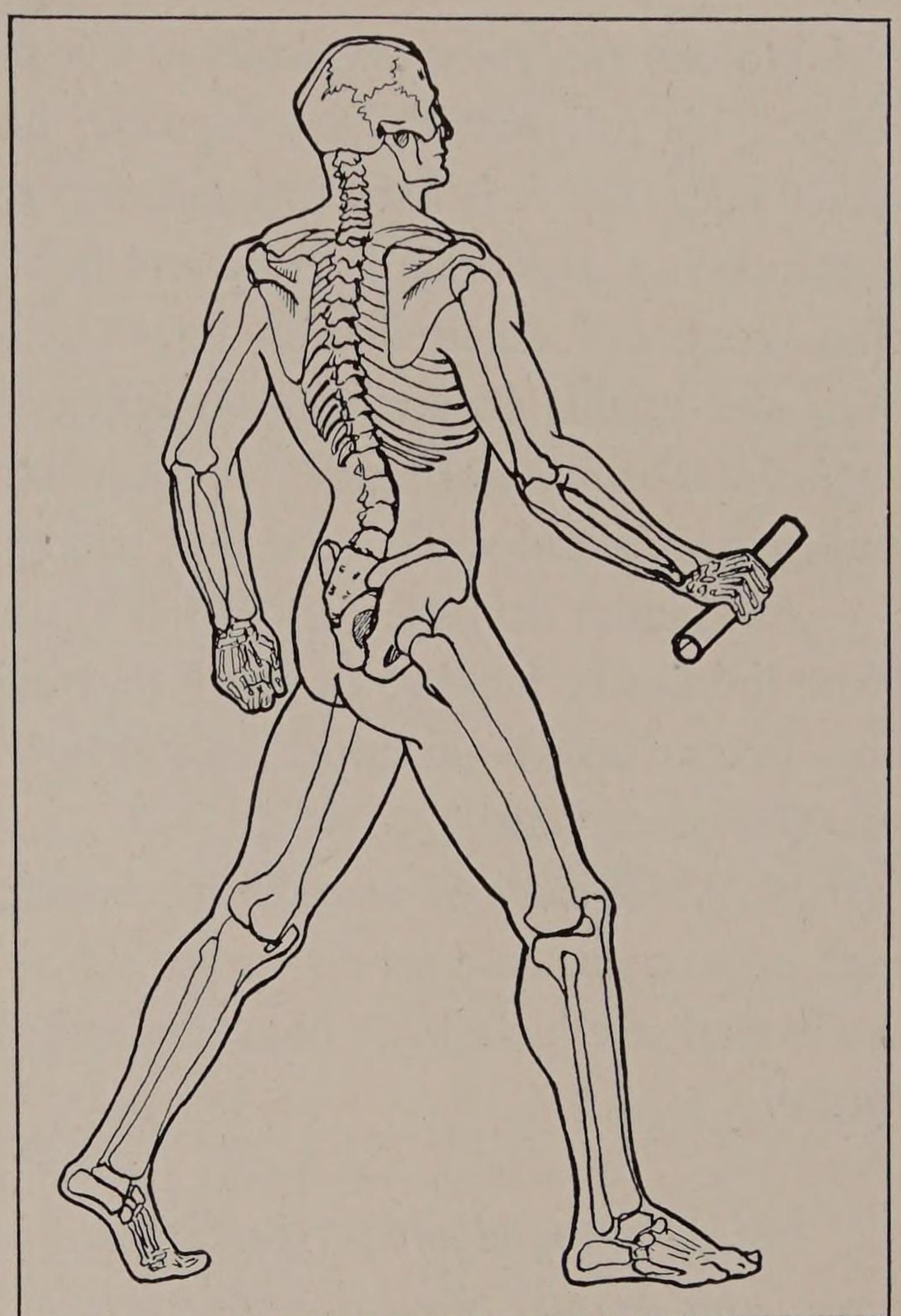


DIAGRAM 18

But the gorilla of today is most certainly a cousin of the apelike animals from which *homo sapiens* sprang. The chimpanzee is perhaps the most intelligent of all apes. He, too, has the characteristic short legs and powerful arms. All these creatures still use their arms to aid them in walking, as does the child before his legs grow strong enough to hold him upright. The round shoulders of the apes are caused by long "spines," which project from the vertebrae. Man still has a vestige of these "spines," the lowest neck vertebra forming a distinct "button" which may be clearly felt.

Early man was undoubtedly squat, hairy and ungainly. But his legs were gradually increasing in length and in strength, his arms becoming shorter and finer, while his hands, guided by ever-increasing intelligence, were learning to fashion tools, build fires, make homes. He invented a real language; he lived in caves and decorated them in response to a new craving for self-expression. He became without question the most intelligent creature on earth.

No one can yet say whether or not man, as we now see him (Diagram 18), has reached his full physical development; he has existed such a very brief time, as the world goes. But it is hard to imagine a creature more perfect than the finest type of human being. His brain is large and intelligent; his features refined and delicate; his chin strong with determination. His chest is wide; his arms, no longer used for locomotion, are capable of an infinite variety of movement. His hand is developed to an exquisite sensibility of touch. His body has a truly mathematical beauty of proportion, and he stands and walks erect and triumphant.

As Hamlet expresses it: "What a piece of work is a man! How noble in reason! How infinite in faculty! In form, in moving, how express and admirable. In action how like an angel—in apprehension how like a god! The beauty of the world—the paragon of animals!"

No artist can fail to catch his breath at the sheer beauty of a perfectly formed man or woman. And when we see the spirit shining through both the physical and the mental, we have high hopes indeed for what man may become in the far-distant future.

THE SKELETON

Before you read any further, let me give you a word of advice: don't try to read the rest of this chapter through at one sitting. If you do, you will find it utterly confusing and baffling. Anatomy is complicated. One paragraph at a time is all you should try to absorb. Read slowly, checking the printed word with the diagrams and photographs to be sure each point is thoroughly clear before you pass on to the next. Even studying anatomy thus slowly and carefully, you must not expect to know it when you have finished the chapter. It must be restudied again and again, not only by reference to these pages, but by every new study you make of the living model. You will make discoveries for yourself—find important truths which, in this somewhat sketchy résumé, I may have slighted or overlooked altogether. This chapter is but a guide, a sort of armature, on which to build your own understanding of nature.

Anatomy means to the artist a very different thing from what it means to the surgeon. The surgeon must familiarize himself with every last detail of bony construction and of muscular attachment, besides having a thorough knowledge of the circulatory, digestive and nervous system, all of which have no interest for the sculptor. It is more important for *us* to understand the shape of the entire thorax than to know

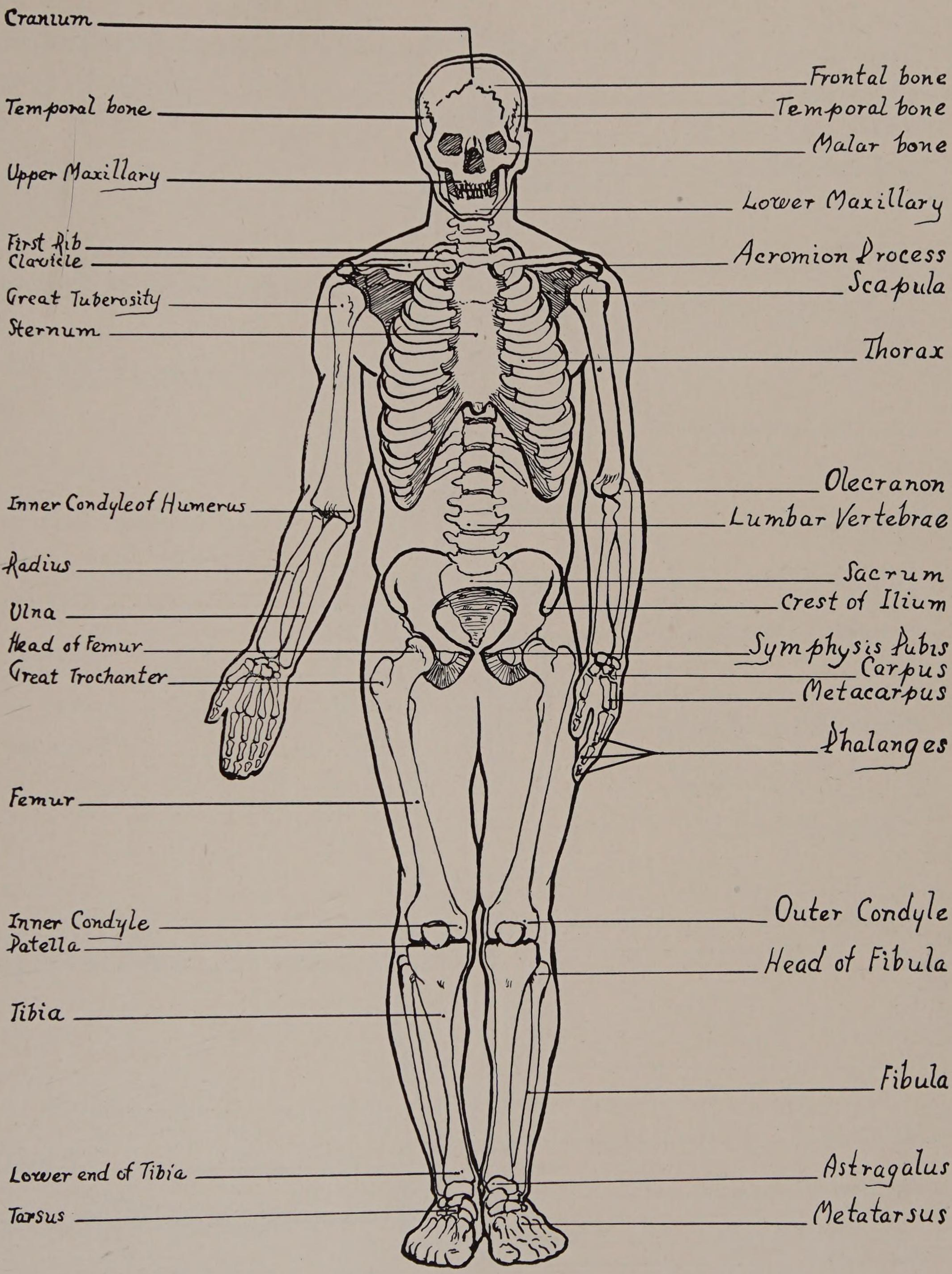

Cranium
Temporal bone
Upper Maxillary
First Rib
Clavicle
Great Tuberosity
Sternum
Inner Condyle of Humerus
Radius
Ulna
Head of Femur
Great Trochanter
Femur
Inner Condyle
Patella
Tibia
Lower end of Tibia
Tarsus
Frontal bone
Temporal bone
Malar bone
Lower Maxillary
Acromion Process
Scapula
Thorax
Olecranon
Lumbar Vertebrae
Sacrum
Crest of Ilium
Symphysis Pubis
Carpus
Metacarpus
Phalanges
Outer Condyle
Head of Fibula
Fibula
Astragalus
Metatarsus

DIAGRAM 19

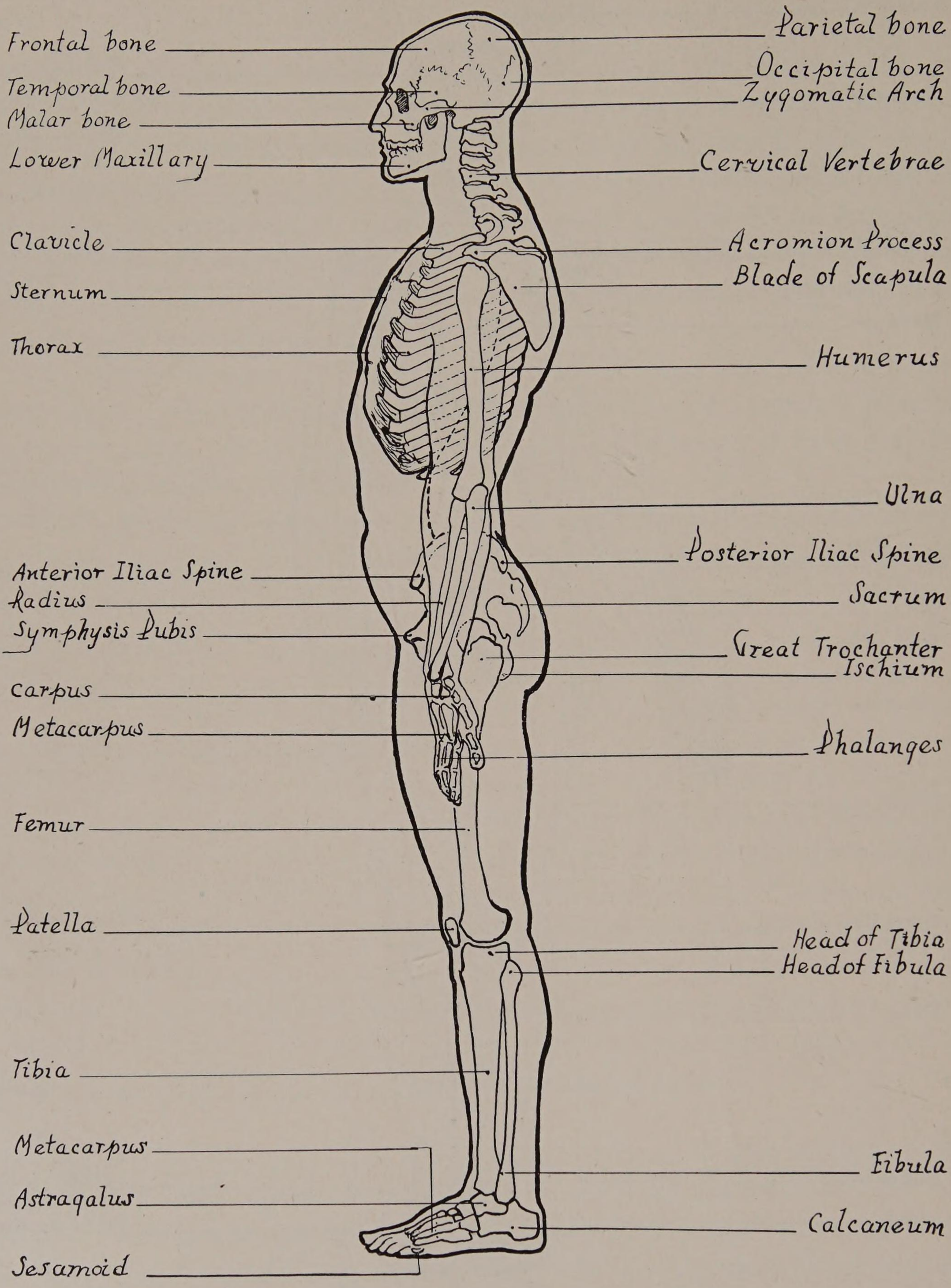

Frontal bone
Temporal bone
Malar bone
Lower Maxillary
Clavicle
Sternum
Thorax
Anterior Iliac Spine
Radius
Symphysis Pubis
Carpus
Metacarpus
Femur
Patella
Tibia
Metacarpus
Astragalus
Sesamoid
Parietal bone
Occipital bone
Zygomatic Arch
Cervical Vertebrae
Acromion Process
Blade of Scapula
Humerus
Ulna
Posterior Iliac Spine
Sacrum
Great Trochanter
Ischium
Phalanges
Head of Tibia
Head of Fibula
Fibula
Calcaneum

DIAGRAM 20

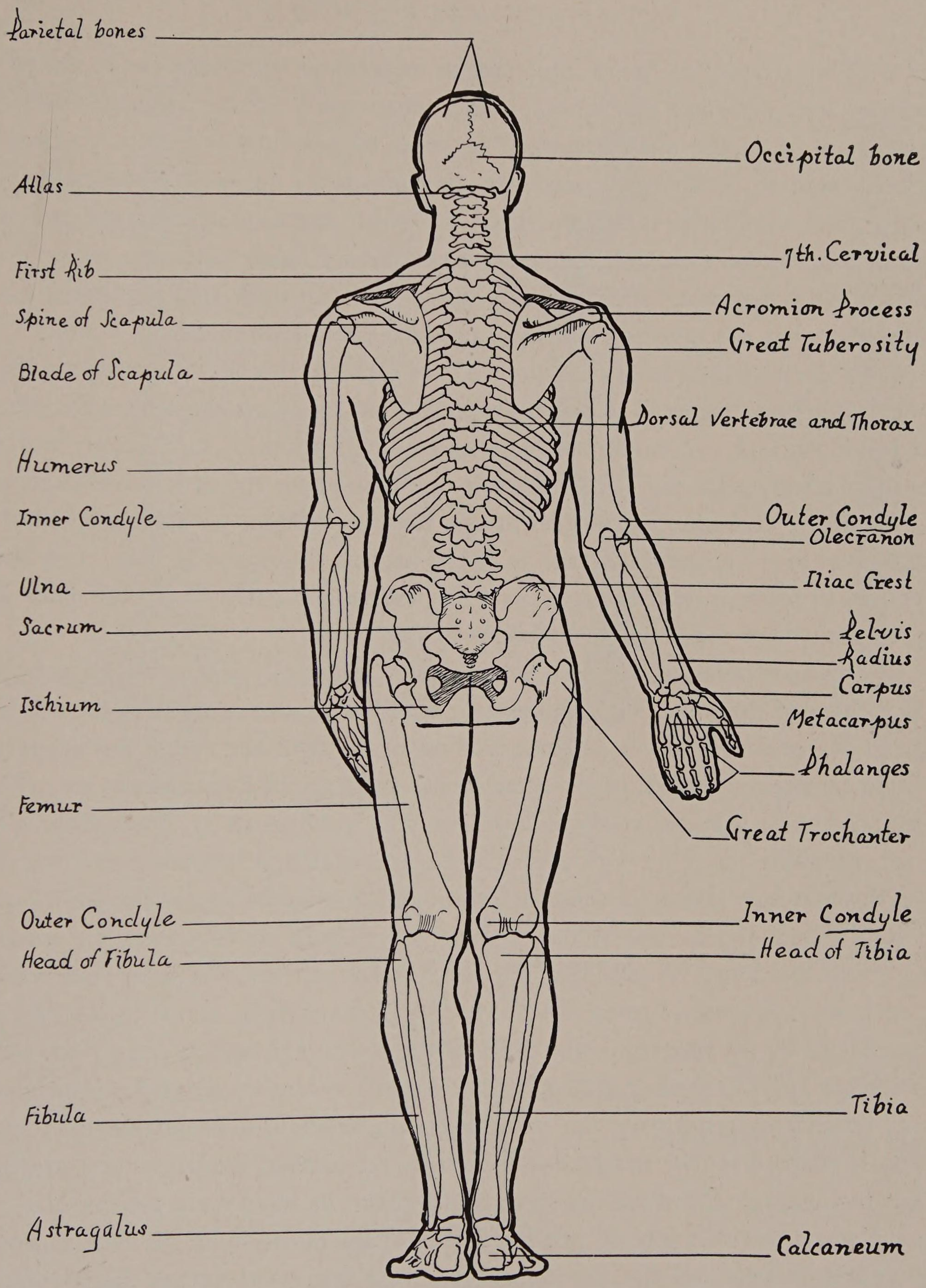

Parietal bones
Occipital bone
Atlas
7th. Cervical
First Rib
Acromion Process
Spine of Scapula
Great Tuberosity
Blade of Scapula
Dorsal Vertebrae and Thorax
Humerus
Outer Condyle
Inner Condyle
Olecranon
Ulna
Iliac Crest
Sacrum
Pelvis
Radius
Carpus
Ischium
Metacarpus
Phalanges
Femur
Great Trochanter
Outer Condyle
Inner Condyle
Head of Fibula
Head of Tibia
Fibula
Tibia
Astragalus
Calcaneum

DIAGRAM 21

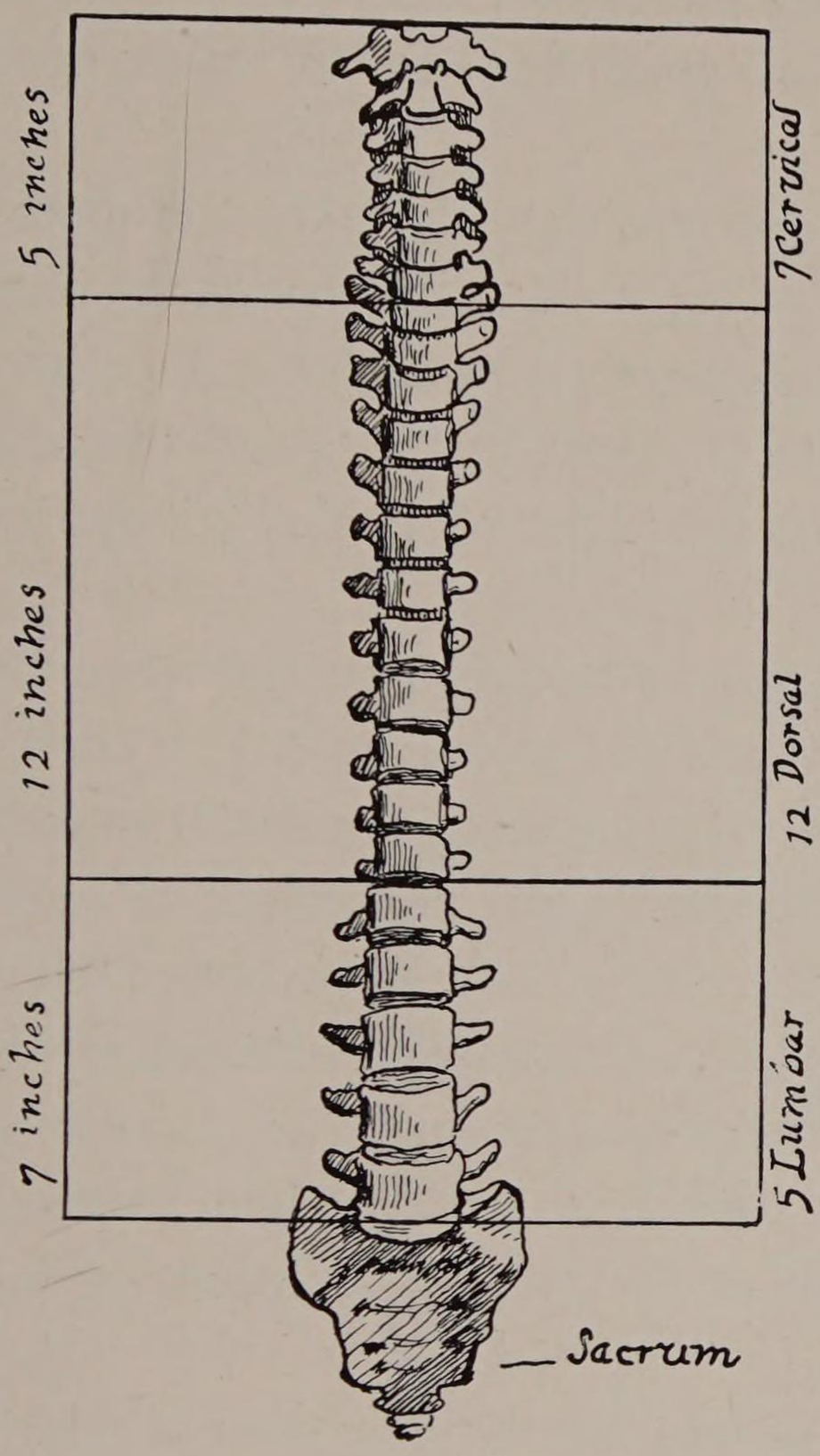
how each rib is attached; more important to understand what happens to the pelvis when the body is thrown off balance, than to know every hidden ligament that holds the thigh in its socket; more important to know by heart the proper proportions of the body than to be able to name every tiny muscle in the face. Nevertheless, the sculptor must familiarize himself with all the major essentials of bony and muscular construction, not only that he may erect a satisfactory figure without a model from which to copy, but that, when he has a model, he may study him intelligently and understand what is happening within to produce the infinite variations without.

From the preceding brief summary we have gathered that the two prime requisites for any vertebrate frame or skeleton are a skull and a spine; the later additions of two forelimbs and two hindlimbs—the astounding variety in their shape, and the uses to which they are put—are the result of environment and special development.

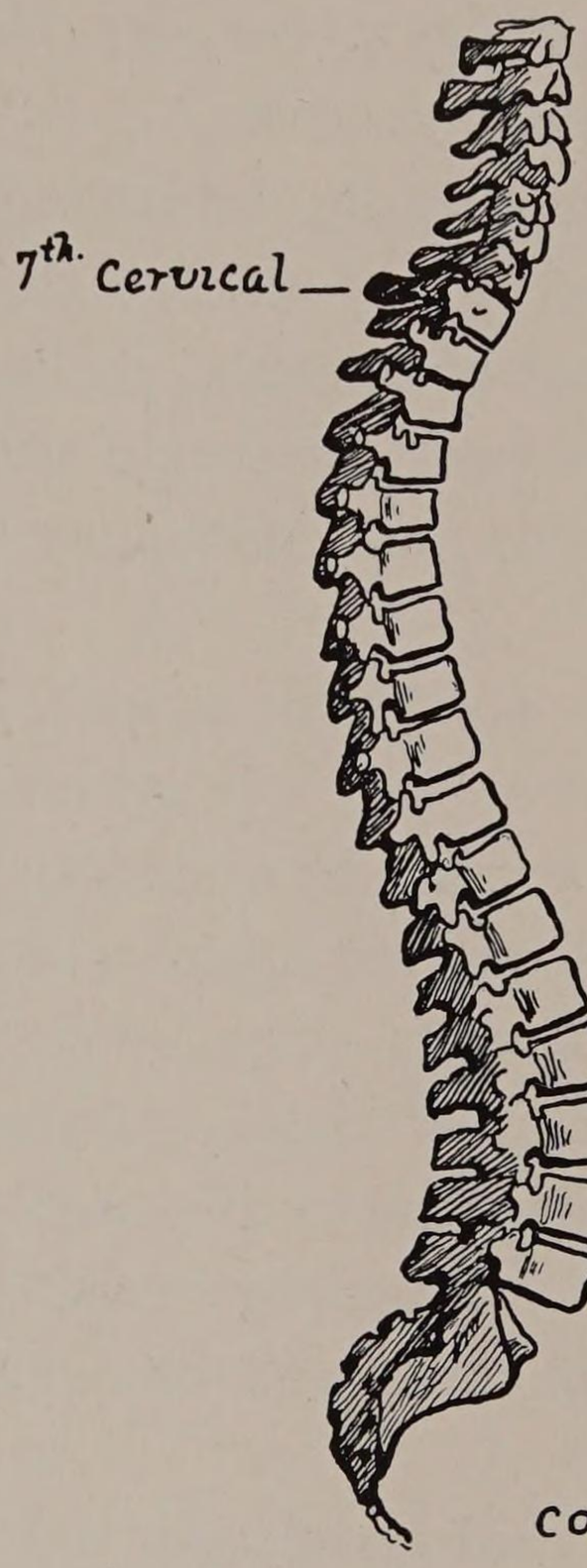
Logically, therefore, in considering the human skeleton, we turn first either to the head or to the spine. The skull, as it has become developed in man, is in many ways less structurally important, so we will reserve our study of it until later and turn to the spine—the veritable backbone of our frame.

The various bones of the body are roughly classed as follows: irregular bones, such as those of the spine, wrist, ankle, etc.; long bones, such as those of the arm and leg; and flat, or containing, bones, such as those of the skull, the thorax and the pelvis.

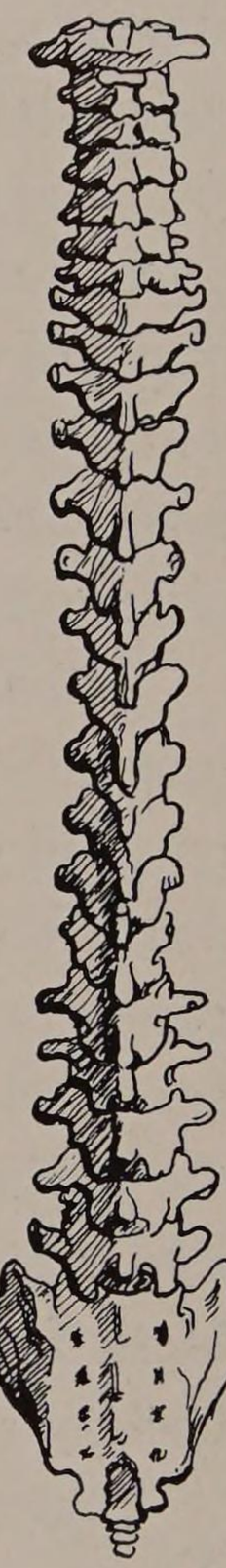
The twenty-four bones, or vertebrae, which make up the flexible chain we call the spine, are indeed irregular in shape as will be seen in Diagram 23. These little bones are set one above the other with a wedge of elastic cartilage between every two; and down through each "bead" of this chain, through a hole in the base of the skull, passes the very thread of life—the spinal cord. In a well-built six-foot man, the spine is exactly two feet long. We divide it into three major sections: the seven vertebrae of the neck we call *cervical* vertebrae; the twelve in the middle, to which the ribs are attached, are *dorsal* vertebrae; and those at the lower end, which occupy the space between rib basket *(thorax)* and pelvis, are known as *lumbar* vertebrae. Each group has its peculiar characteristics: the cervicals are the smallest, most flexible; the dorsals especially adapted for the attachment of the ribs; the lumbar, the largest and strongest of all. In Diagram 22 we see the spine divided into its three main groups, and find that the seven cervicals take up just five inches of the twenty-four; the twelve dorsals take twelve inches; and the five lumbar take the last seven inches. Each vertebra possesses a central "spine" or projection of bone which thrusts downward and out-



A

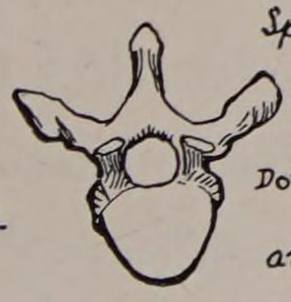


B



C

DIAGRAM 22



A



B



C

DIAGRAM 23

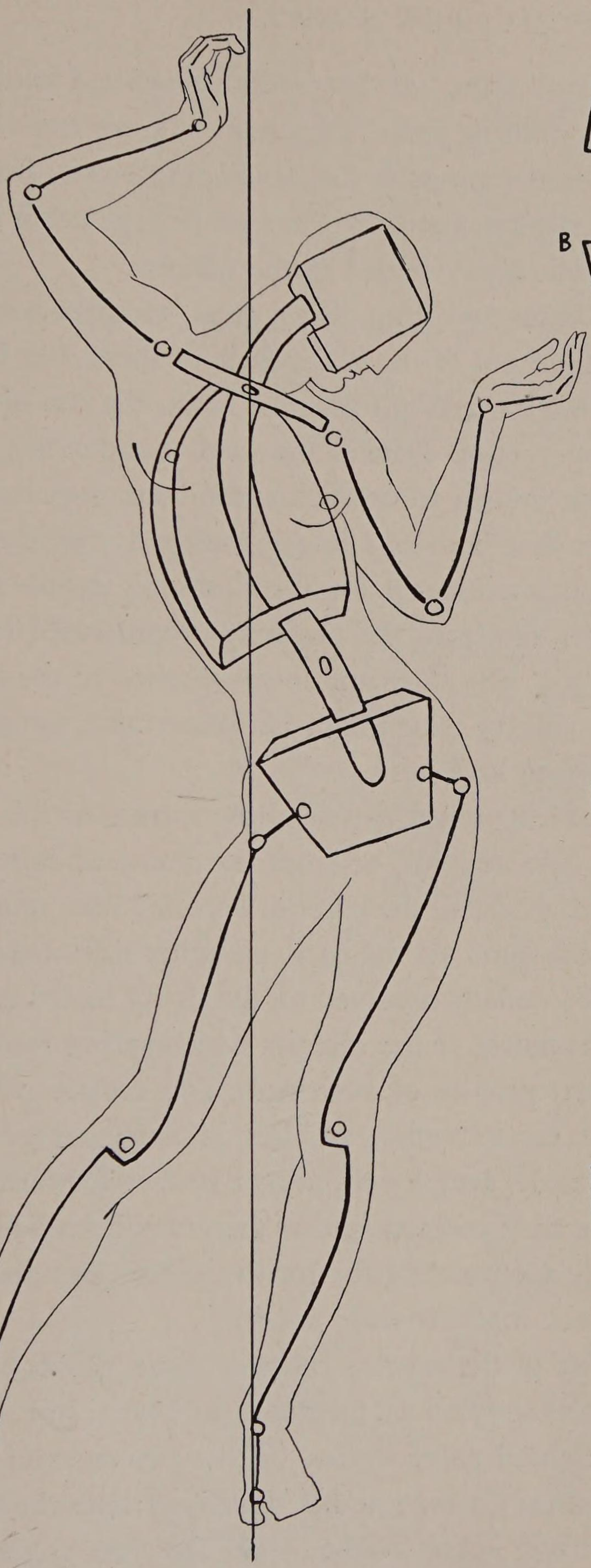
ward, overlapping the vertebra below and forming the row of "buttons" we notice along the back when the body is bent over. The most prominent "button" in the neck region is that of the *seventh cervical.*

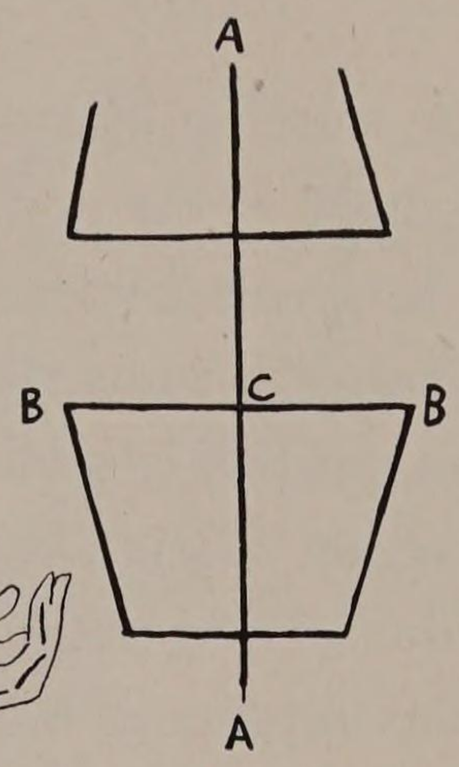
The first two cervicals are also interesting in different ways: Number 1 is appropriately called *atlas,* since it supports the "globe" of the skull. It has, beside the hole through which the spinal cord passes, yet another cavity on its under surface into which a spike of bone from the second vertebra is inserted. This spike forms a pivot which adds flexibility to the neck movements, and vertebra Number 2 is appropriately termed *axis.*

As we see the spine from front or back, it appears a straight line. But when we look at the side view we see that it is anything *but* straight (Diagram 22). It curves outward from the head toward the shoulders, forward again along the dorsal toward the lumbar region, and outward again at the lower end. The importance of these curves cannot be overestimated—they are the very curves of Life itself. How useless and false it is, therefore, in art schools and anatomy clinics to suspend a skeleton from the ceiling and allow the spine to drop into a lifeless straight line! The undulating line is the living line, most especially in man who, in order to stand upright, balances himself by the alternate thrust and counterthrust of the varying directions of his backbone.

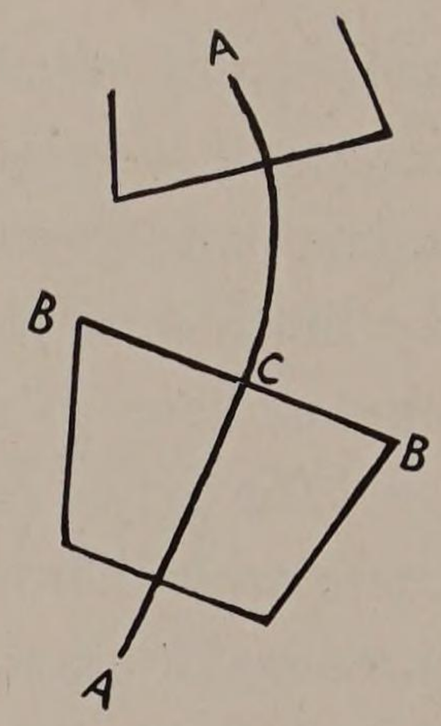
Forward and backward undulations are, of course, not the only ones of which this flexible chain is capable. Diagram 24 gives an idea of the lateral bends that are possible. In this diagram, I have very gratefully borrowed the general idea from William Rimmer and from George Bridgman. The latter makes it very plain to the student that the skull, the thorax and the pelvis are boxes—solid, fixed objects, joined together by a flexible strip of spine (Diagram 25). It may appear to you that the pose of Diagram 24 is an exaggeration of what is humanly possible, yet dancers frequently assume such a pose and the best way to sketch them is to begin with a foundation very like this one. Note that in this pose the entire mass of the hips is thrust sideways far beyond the central perpendicular line.

Returning to Diagram 22 you will note that below the fifth lumbar vertebra something happens. The "beads" of the chain suddenly solidify into a single, curved, wedge-shaped bone. This is known as the *sacrum.* In quadrupeds with tails, this sacrum is merely a hiatus, an abrupt solidifying of a few vertebrae, between the chain of the backbone and that of the tail. In man there remains only a vestige of this tail—three

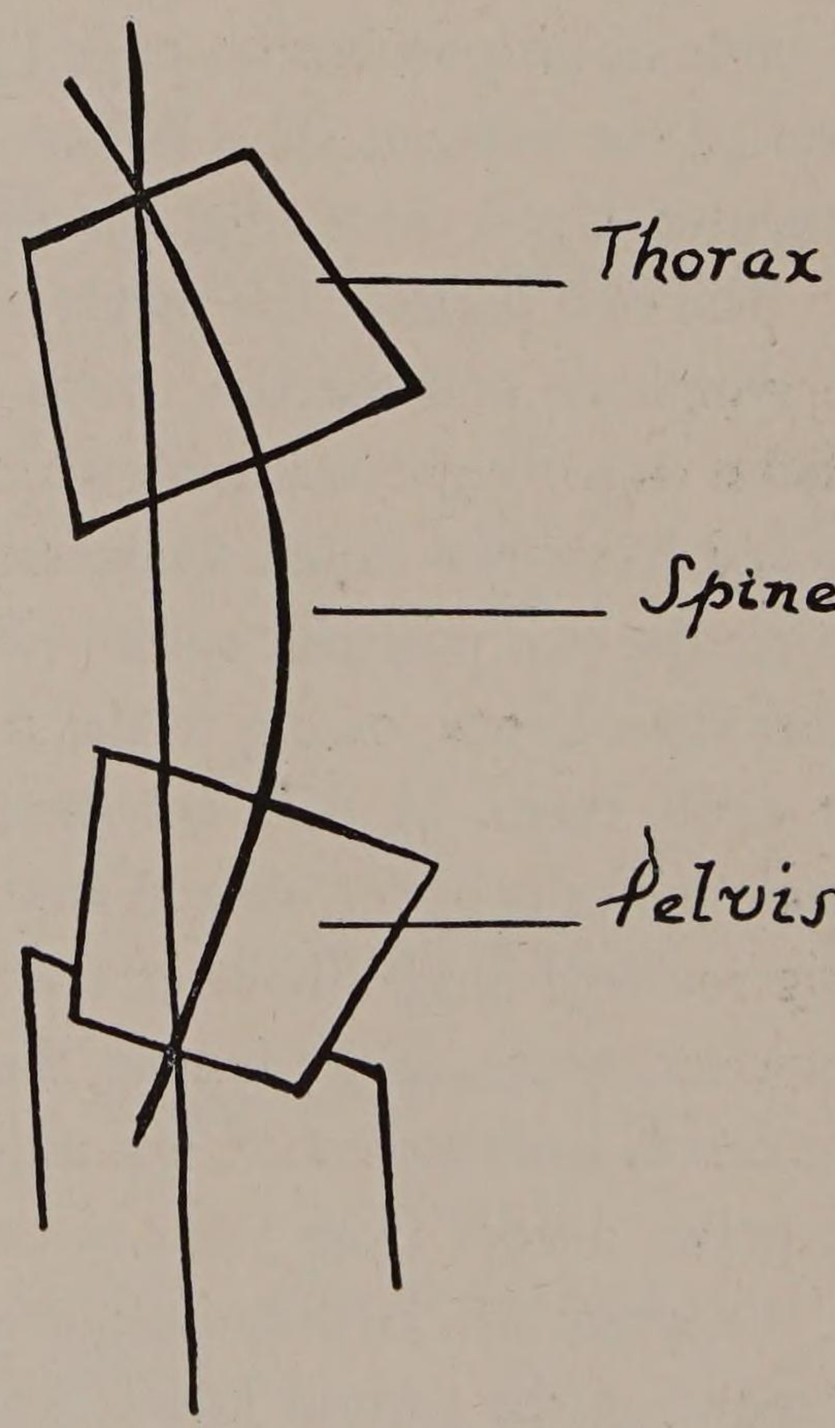




No. 1



No. 2



No. 3

DIAGRAM 24

DIAGRAM 25

or four tiny vertebrae, curving inward at the very tip of the sacrum and known as the *coccyx.* If we glance back to the prehistoric lizard (Diagram 15), we realize that the sacrum was formed to give substantial support to the developing pelvis, from which the limbs were beginning to grow. Every creature that stands on legs needs this rigid support here, so man's pelvis is immovably welded to the sacrum.

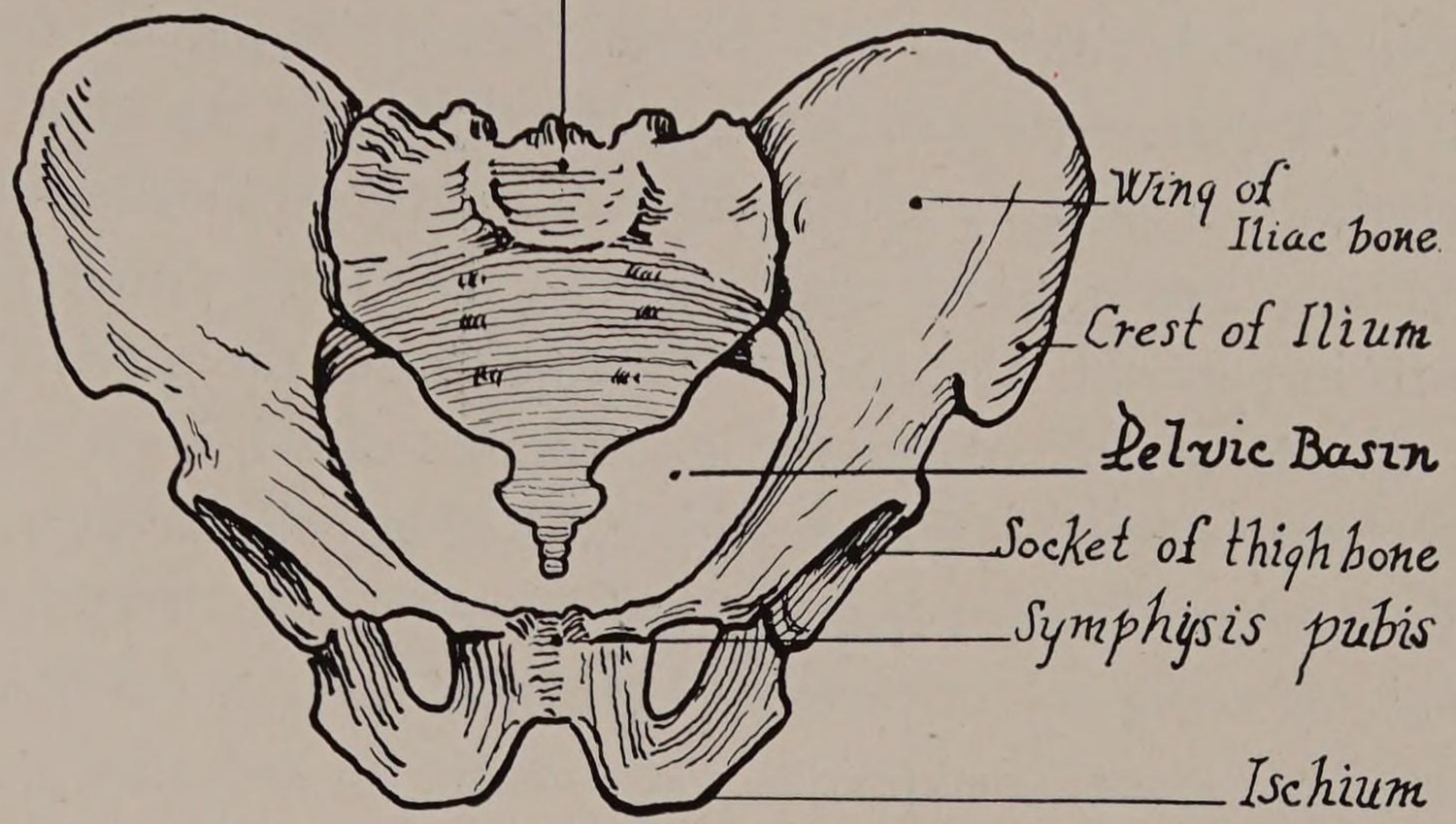
The pelvis (Diagram 26) is a basin consisting of two great, winglike bones which curve around from the sacrum to the front of the body. Each of these *iliac* bones has three major parts: the upper and largest section forms the basin, the rim of which is known as the *iliac crest.* The central portion contains the deep, round socket in which the head of the thighbone revolves; and in front of this, the bone projects forward meeting the projection of the other iliac bone in a bridge known as *symphysis pubis.* This is, structurally speaking, a most important point, for it not only defines the lower abdominal wall, but marks the very center of the perfectly proportioned body (see the table of proportions on page 156). The third and lowest portion of the iliac bone is called the *ischium.* This hollow ring of bone might be likened to a roughly made doughnut. Upon these rings the sitting body rests.

The two parts of the pelvis which project closest to the surface of the body are the symphysis and the iliac crest. The anterior, or front, extremity of this crest terminates in a roughened knob which is called the anterior superior iliac spine. Below this is a lesser one called the inferior spine. At the back, on either side of the sacrum, project the two posterior spines (B) usually observed on the living model as dimples rather than knobs, owing to the thickness of the muscles which spring from, but do not cover them. In (C) are shown profiles of both male and female pelves. The female pelvis is wider, shorter from top to bottom, and lies, as seen from the side, at a more forward angle. Thus in the male, symphysis projects further forward than the iliac crest, while, in the female, the crest projects further than symphysis. Her sacrum, too, curves outward more, not only accentuating the forward angle, but also making her pelvis deeper from front to back than the male pelvis.

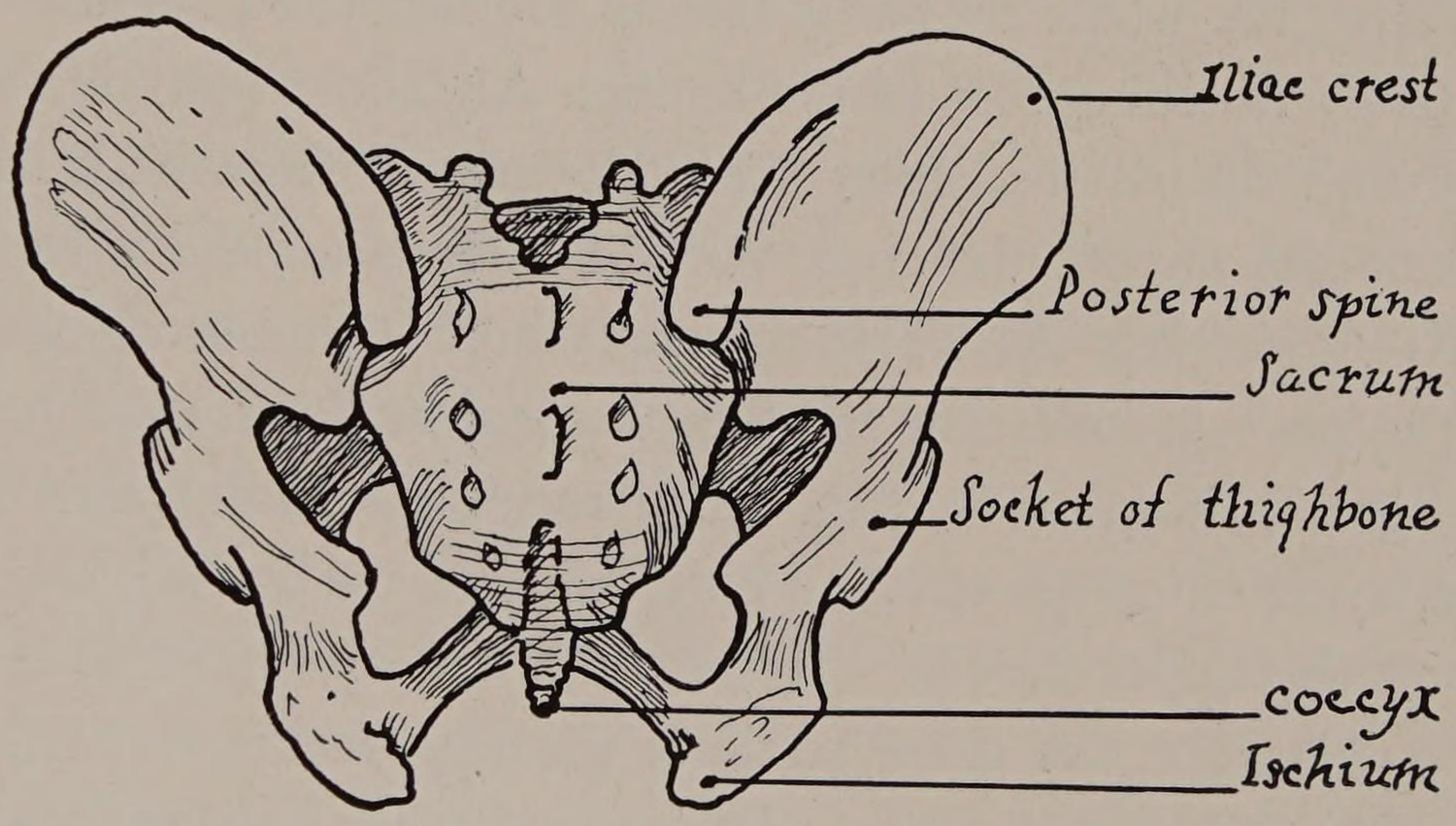
Diagram 25 clarifies the picture of the relation between spine, thorax and pelvis by reducing the natural forms to the simplest of diagrams. In No. 1, line AA represents the spine, connecting thoracic and pelvic boxes. As the two sides of the torso are symmetrical, the line AA bisects (at C) the line BB, which indicates the horizontal top of the pelvic box. Point C is fixed, angles formed there are right angles.

Now what happens when, as in No. 2, the weight is so shifted that one leg bears

A

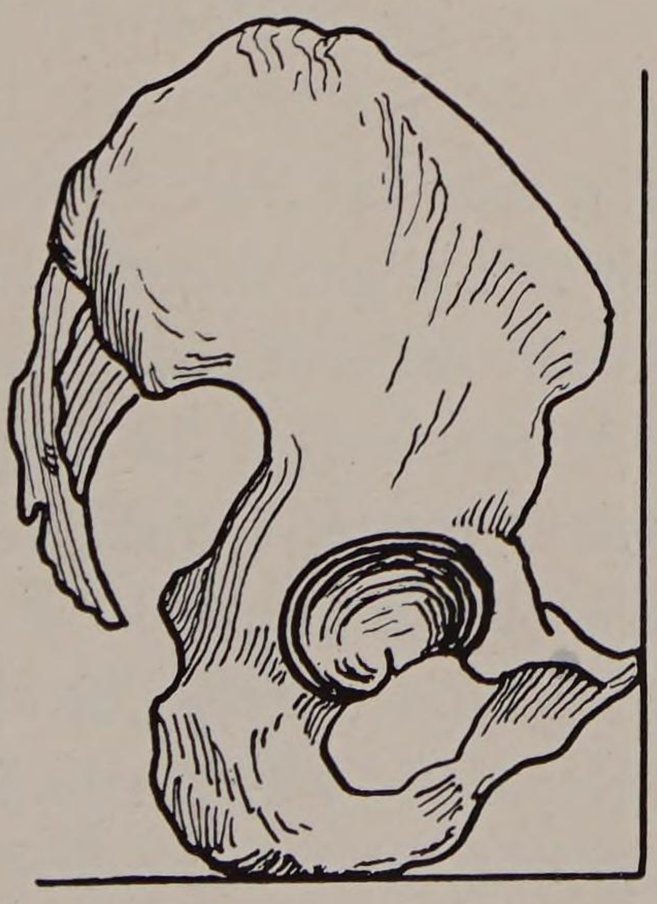


B



C

Male



Female

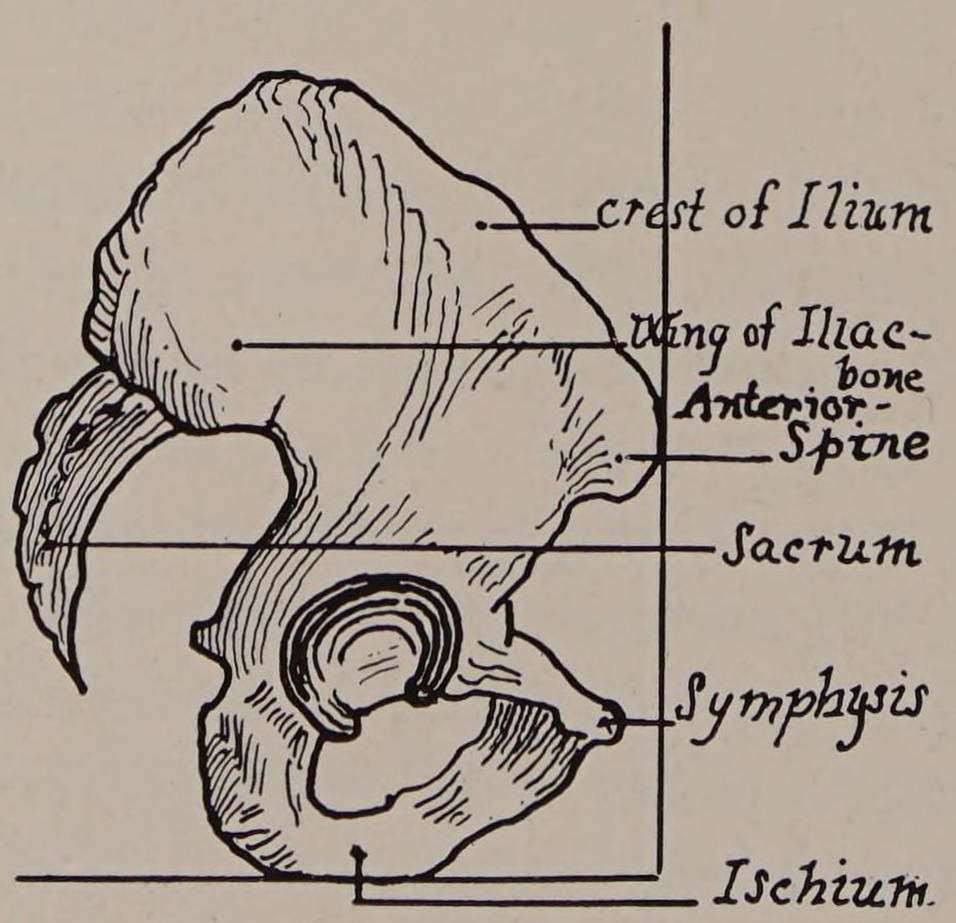


DIAGRAM 26

it all, while the other relaxes and droops? The entire pelvic box shifts too, so that line BB is no longer horizontal. But at the fixed point C, the spine must still bisect BB at right angles. Temporarily it is thrown off the perpendicular, but being a flexible, not a rigid line, it swings back again, carrying the thorax with it until at the pit of the neck it falls in perpendicular line with the bottom of the pelvis (No. 3).

The thorax, or rib basket, as it is sometimes called, is not as rigid a box as the pelvis, but rather resembles a crate with more or less elastic slats. These slats, or ribs, are twenty-four in all, with one attached to either side of each dorsal vertebra. In Diagram 23, showing one of these vertebrae, we see how the ribs articulate with the spine. Note that there are two points of attachment for each rib—an inner and an outer.

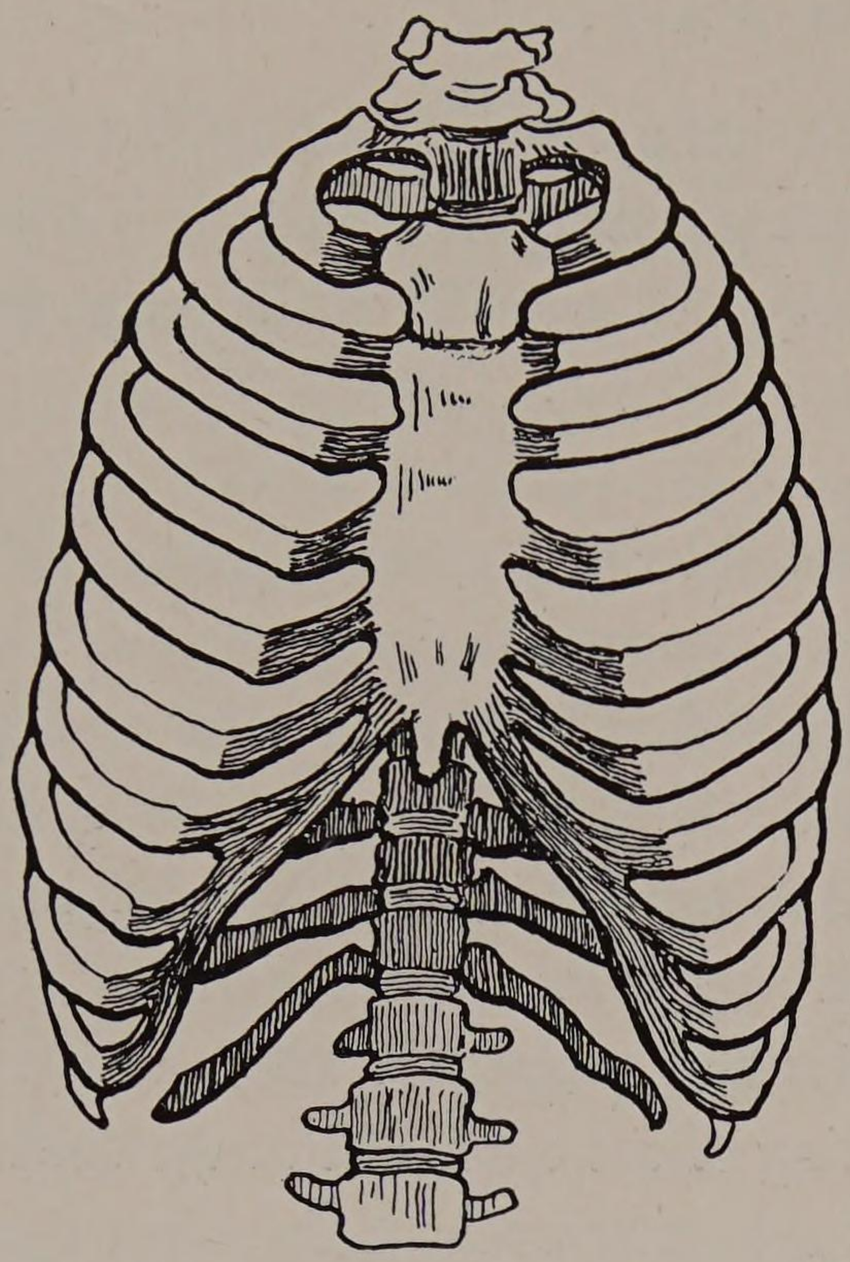
In shape, the whole thorax is like an old-fashioned beehive—narrow at the top and gradually widening toward the bottom. A glance at the side view (Diagram 27) shows us that the whole basket slants downward from back to front, so that the ribs do not run around the chest wall like hoops around a barrel, but they thrust diagonally downward. As we learn more about anatomy we see evidence on every hand of nature's predilection for the diagonal and the spiral, especially along the sides of figures. Diagram 51, page 151, stresses this point; while front and back have duplicate, symmetrical patterns on either side of the median line (Diagram 50).

Along the upper part of the chest the ribs are attached to the breastbone, or *sternum.* This bone has three sections; the upper part, or "hilt of the sword," is roughly square in shape. Its top defines that most important measuring point—*the pit of the neck.* The hilt joins the sword, or main shaft, at a slight angle, which is often noticeable on a thin model. The two collarbones, or *clavicles,* attach to the hilt just above the first two ribs. The "blade" is longer, curves slightly outward and is usually wider below than above. The third, and smallest section, is a little receding appendage, or tail, which shows on the surface of the body as a slight depression. Along either side of the blade, attached not directly but by short strips of elastic cartilage, are the forward ends of the ribs. As will be seen in Diagram 27A, the strips of cartilage become longer as they descend and, as the whole thorax is much longer than the sternum, the cartilages of the lower ribs sweep upward to meet it. Those of the seventh, eighth, ninth and tenth ribs, indeed, merge into one long band which defines the anterior boundary of the chest wall. The eleventh and twelfth ribs are so short that they do not extend around to the front of the body and, being free at their outer ends, are called "floating ribs." Of course it is the cartilage which enables the thoracic

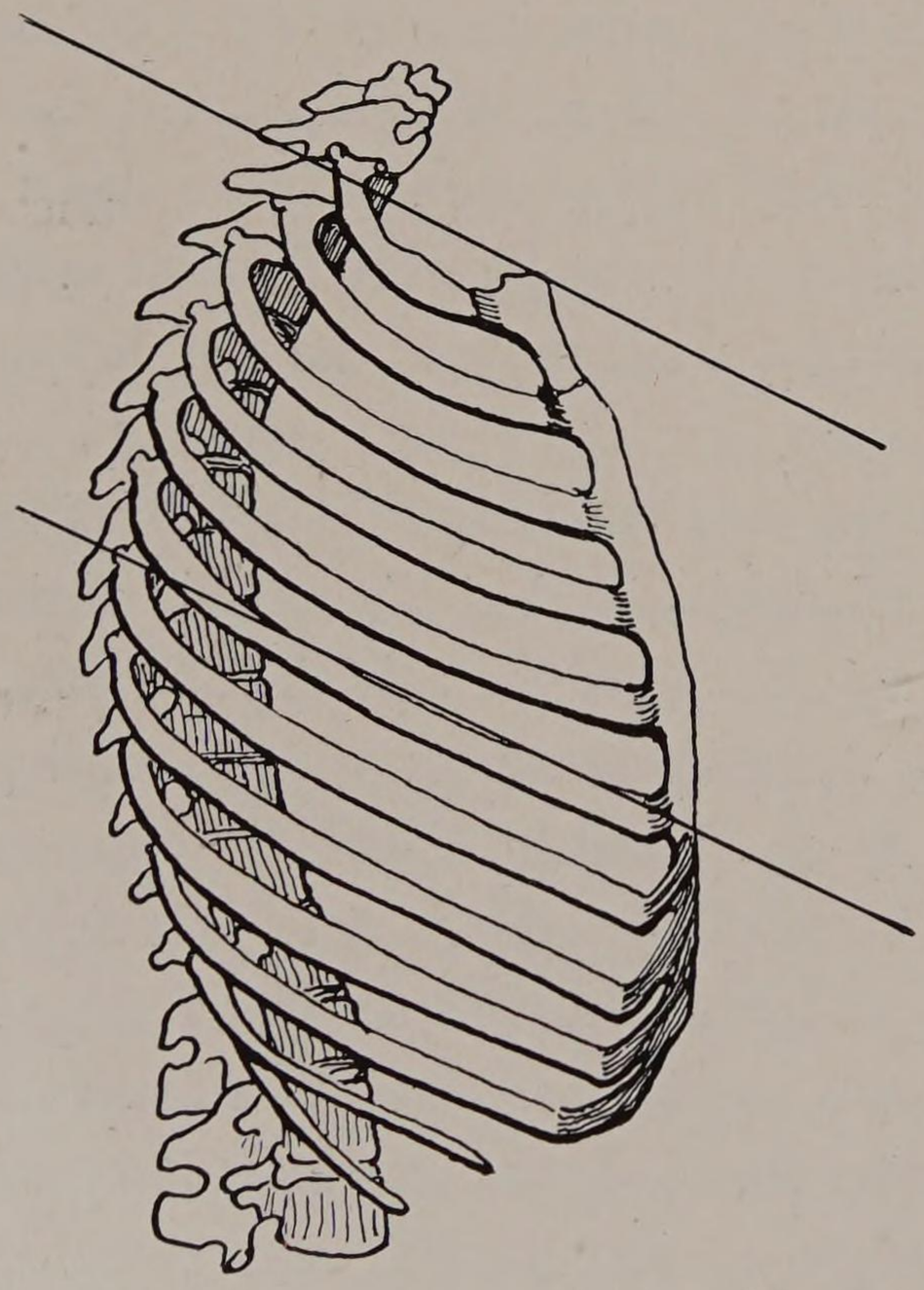
"crate" to expand and contract with breathing. The thorax is wider from side to side than it is from front to back—a result of man's erect posture, for in animals it is just the reverse. The female thorax is not only relatively, but actually smaller than that of the male.

The Shoulder Girdle—When we speak of the shoulder girdle, or the pelvic girdle, we refer to the bony structure by which the limbs are attached to the spine—the main trunk of the tree. As we have seen, the pelvic girdle is developed mostly for strength and for the support of the trunk above, the one flexible part being the "ball and socket" joint of the thigh. But the shoulder girdle, not having to bear weight, is far more delicately designed and capable of more mobility. It comprises the two collarbones and the two shoulder blades, (clavicles and *scapulae*). The arm is suspended from a sort of bridge, formed by the meeting of the outer end of the clavicle and the outer end of the scapula. As the scapula's sole attachment to the other bones of the body is through this joint on the shoulder, the arm hanging from it has extraordinary freedom of action. Try placing the fingers on one clavicle, then swing the arm on that side and you will realize how it all pivots upon the inner head of the little clavicle, in its shallow socket beside the pit of the neck. The clavicle is a slightly curved and twisted bone, having a quite round and prominent inner "head" and a flattened outer one. It sweeps outward almost horizontally over the first little rib and beyond the upper part of the thorax, meeting the scapula at the very top of the shoulder.

The two scapulae lie on the back of the thorax, one on either side of the spine, and about two inches from it. They are roughly triangular, with the inner side of the triangle almost parallel to the spine when the arm hangs at the side. The moment the arm is lifted, however, or drawn forward, the scapula moves with it, sliding smoothly over the rib basket, away from the spine. Running diagonally outward and upward across the upper third of the thin blade of the scapula is a high ridge, or spine, which terminates in a projecting knob of bone called the *acromion process* (Diagram 28). It is to this process that the outer end of the clavicle is attached. Being uncovered by muscles, it lies directly under the skin, showing as a lump on a slim undeveloped shoulder but often as a dimple on the shoulder of a powerful athlete. Underneath this "bridge" formed by the acromion process and the outer end of the clavicle lies the shallow socket in which the upper end of the arm is inserted.



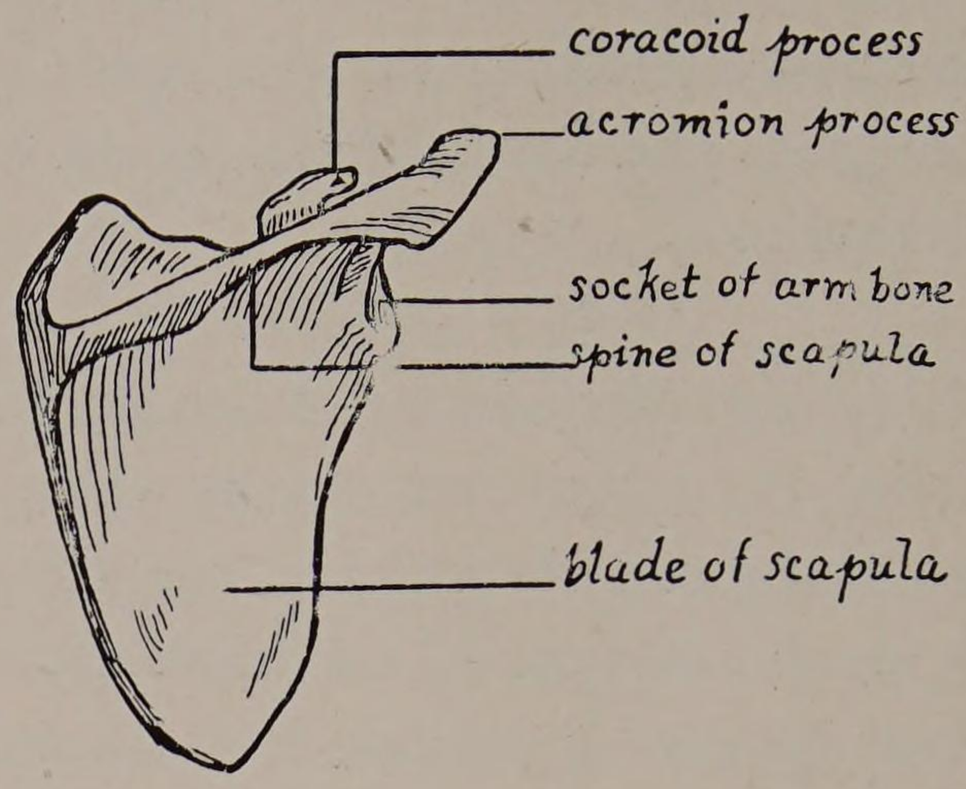
A



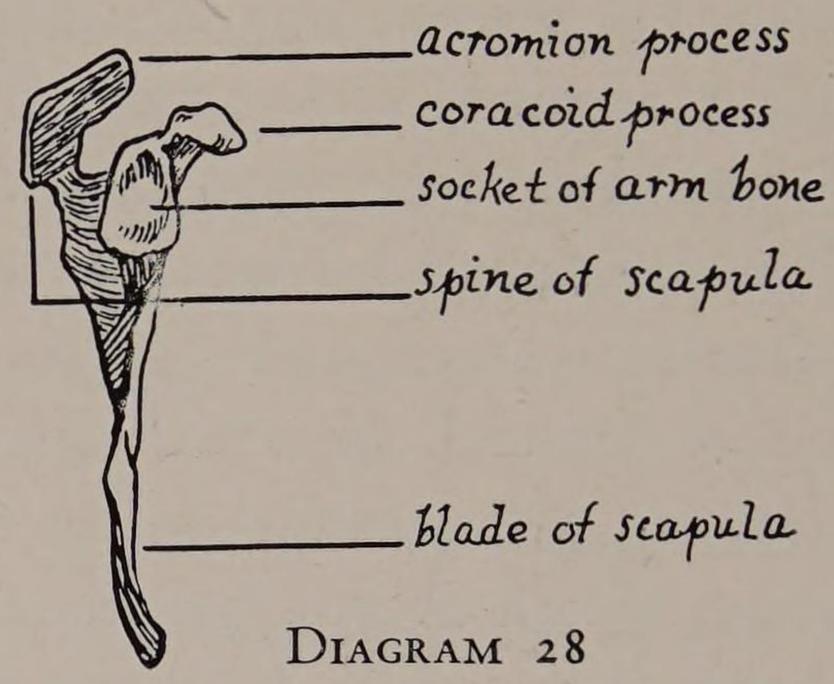
B

Diagram 27

Right Scapula



A



B

Diagram 28

Shoulder Girdle from above

a — 1st. Dorsal Vertebra
b — 1st. Rib
c — top of Sternum
d — Scapulae
e — Acromion Processes
f — Clavicles

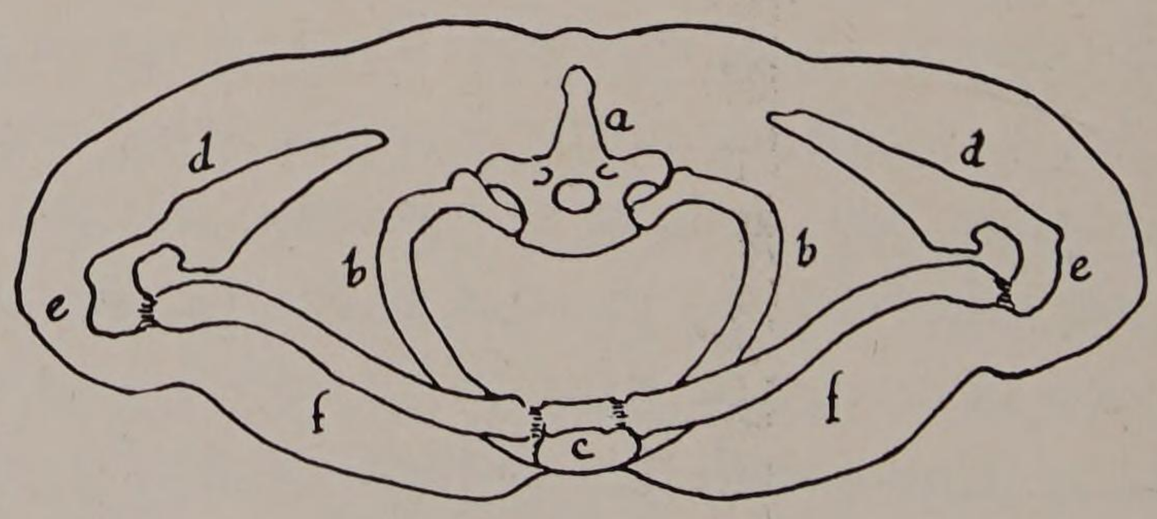


Diagram 29

Just above, and in front of, this socket is another projection of bone called the *coracoid process,* so-called because it resembles a crow's beak (Diagram 28B). The blade of the scapula is extremely thin and lies quite close to the ribs, but the spine of it is very prominent and forms the "shelf" across the shoulders.

Diagram 29 shows a bird's-eye view, or cross section of the shoulder girdle with first dorsal vertebra and first rib. It is a good thing for students to copy such diagrams as an aid to memory.

The Arm—From its socket on the outer edge of the scapula hangs the *humerus,* or bone of the upper arm (Diagram 30). It has a rather long slender shaft, cylindrical near the top and flattened from side to side toward the lower end. The inner surface of the upper "head" is a smoothly rounded hemisphere which glides about easily in its socket, while the outer surface, or *tuberosity,* is quite rough and contains a deep groove along which passes a strong tendon from one of the biceps muscles. Just above the elbow, the humerus widens into two projections, known as the inner and outer *condyles* (Diagram 30). Between these is a smooth spool-like surface over which one of the bones of the forearm slides as the arm is alternately flexed or extended. At the back this smooth surface ends in a hollow, into which the projecting tip of the *ulna* fits when the arm is fully extended. The inner condyle of the humerus is much sharper than the outer and is often quite prominent on a thin model.

Curiously enough, the two bones of the forearm are crossed when hanging naturally: the *radius,* starting from the outer condyle, passes across the ulna to the inner, or "thumb" side of the wrist. Only when we throw the arm and hand outward, with palm up, do these bones lie parallel.

Both ulna and radius have slender shafts with a head at either end, but the upper head of the ulna is larger than that of the radius, while the lower end of the radius is far broader and stronger than that of the ulna. It is the upper head of the ulna which grasps, like a little hand, the spool-like surface between the condyles. Its prominent extremity forms the actual point of the elbow and is called the *olecranon process.* The upper end of the radius, on the other hand, is but a sort of button which articulates with a smooth surface on the front of the outer condyle. Upon this surface it rotates as the radius crosses over the ulna and back again. At the wrist the radius occupies two thirds of the breadth, while the ulna tapers to a button on the outer side.

A very important point to remember about the elbow is that the joint itself is

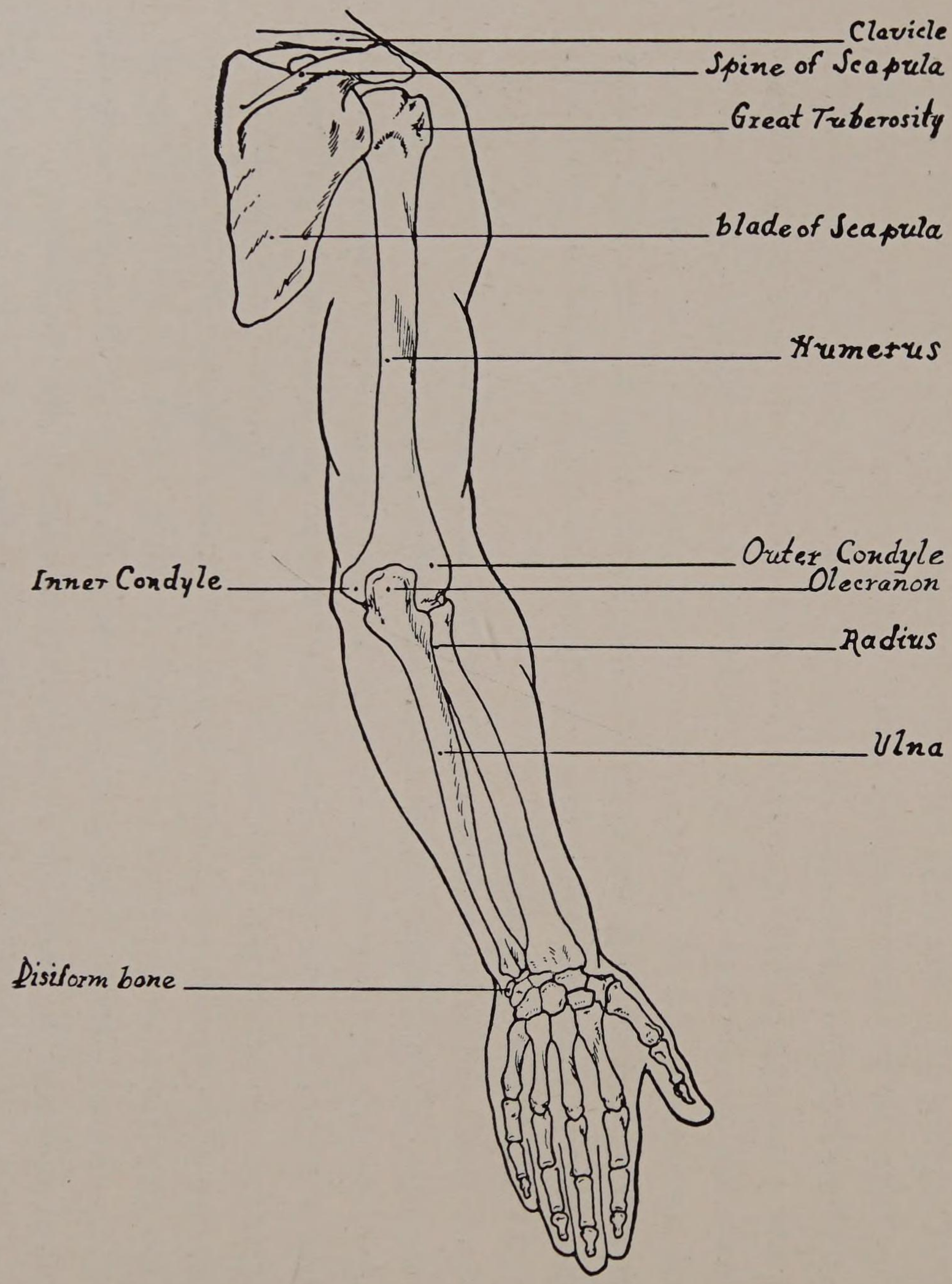
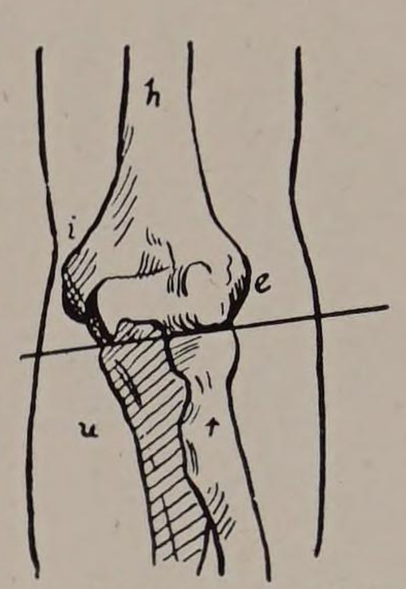


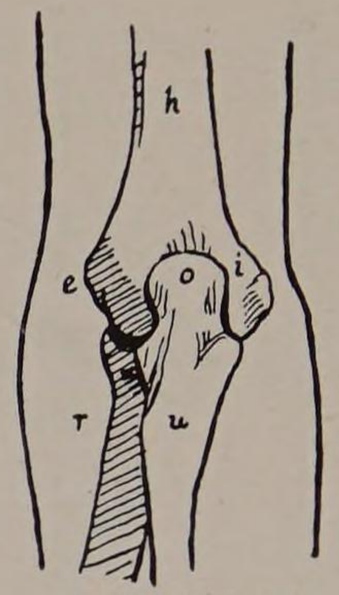
Diagram 30

Bones of the left elbow



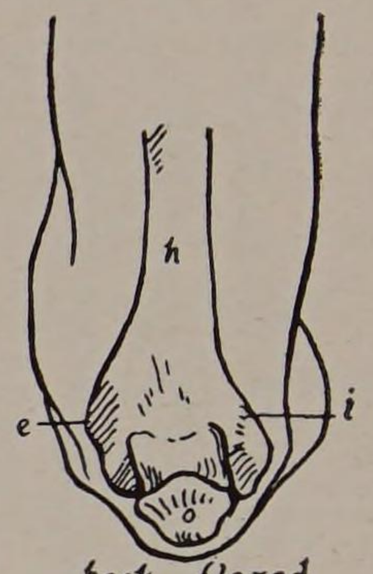
front, extended

A



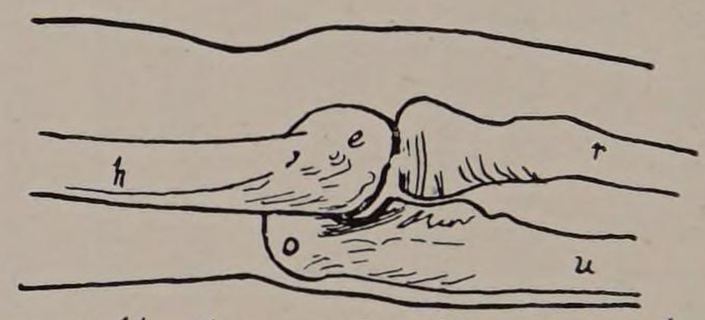
back, extended

B



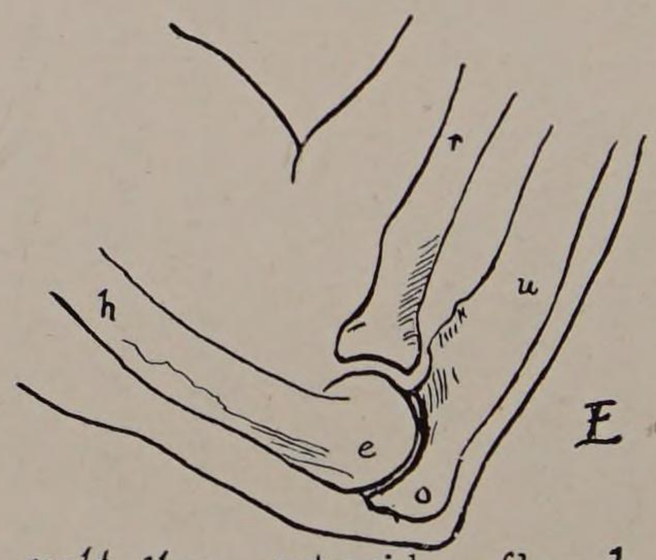
back, flexed

C



right elbow, outer side, extended

D



E

right elbow, outer side, flexed

h - humerus
r - radius
u - ulna
o - olecranon
i - inner condyle
e - outer condyle

Diagram 31

not exactly at right angles to the shafts of the arm bones. The inner condyle is slightly lower than the outer so that the hinge is at an angle (Diagram 32). If the elbows are held close to the sides and then, without moving the upper arm, one turns the hand with thumb outward, one sees immediately that from the elbow down the arm thrusts out, away from the body. Now flex the arm naturally and you find that your hand comes up across your chest, not against the shoulder as it would if the elbow hinge were at right angles to the humerus. Too many artists, both painters and sculptors, who think they know their anatomy, fail to observe this important point, with the result that the arms of their figures are "wooden," and devoid of life and energy.

The movements of the radius across the ulna and back again, and the resultant turning of the hand "palms down" or "palms up," are known as *pronation* and *supination.* Pronation is with the palms of the hands down; supination with the palms up. When we speak of a person lying prone upon the floor, we mean that he is lying face downward. When supine, he is lying upon his back.

The wrist proper, or *carpus,* is composed of eight small, squarish bones knit together in a sort of masonry, which, with the lower ends of radius and ulna, arches gently upward in the center. They lend great flexibility to the wrist. The smallest and roundest of these little carpal bones lies just above the outer edge of the palm. It can be clearly felt if one bends the hand sharply back. In man, this *pisiform* bone seems insignificant, but in quadrupeds it is much enlarged and quite prominent (see Chapter VIII on Comparative Anatomy).

The hand proper is composed of five *metacarpal* bones. Each of these is a characteristic "long" bone, with a shaft and two heads. The upper heads are not easily distinguishable on the back of the hand except as they join the carpus at a slight angle; but their lower heads, where they articulate with the fingers, form the great knuckles. The hand, as well as the wrist, arches upward in the center, the knuckle of the third finger being the most prominent of all. The third metacarpal is also the longest, as is the third finger, with the resultant curves which are indicated in Diagram 33. When the fingers are extended and separated, they and the metacarpal bones radiate fan-shaped from the carpus. But when the fingers are brought together, they are seen to converge at their tips.

The French have a pretty name for the three bones of the fingers, calling them respectively *phalange, phalangine,* and *phalangette.* Close observation of your own hands will teach you more than any amount of written description, but a final word

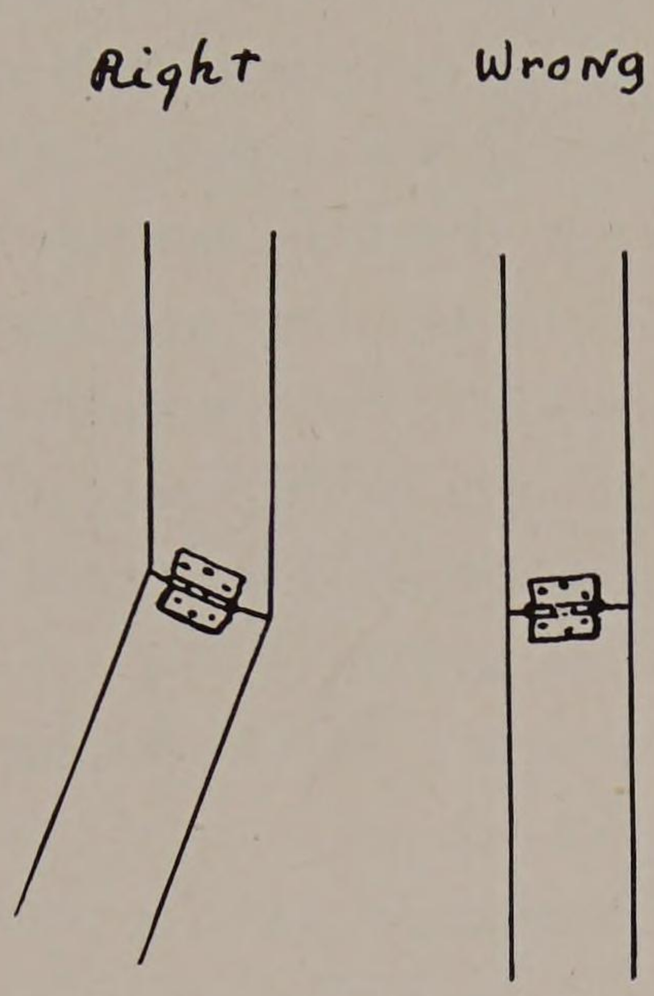


DIAGRAM 32

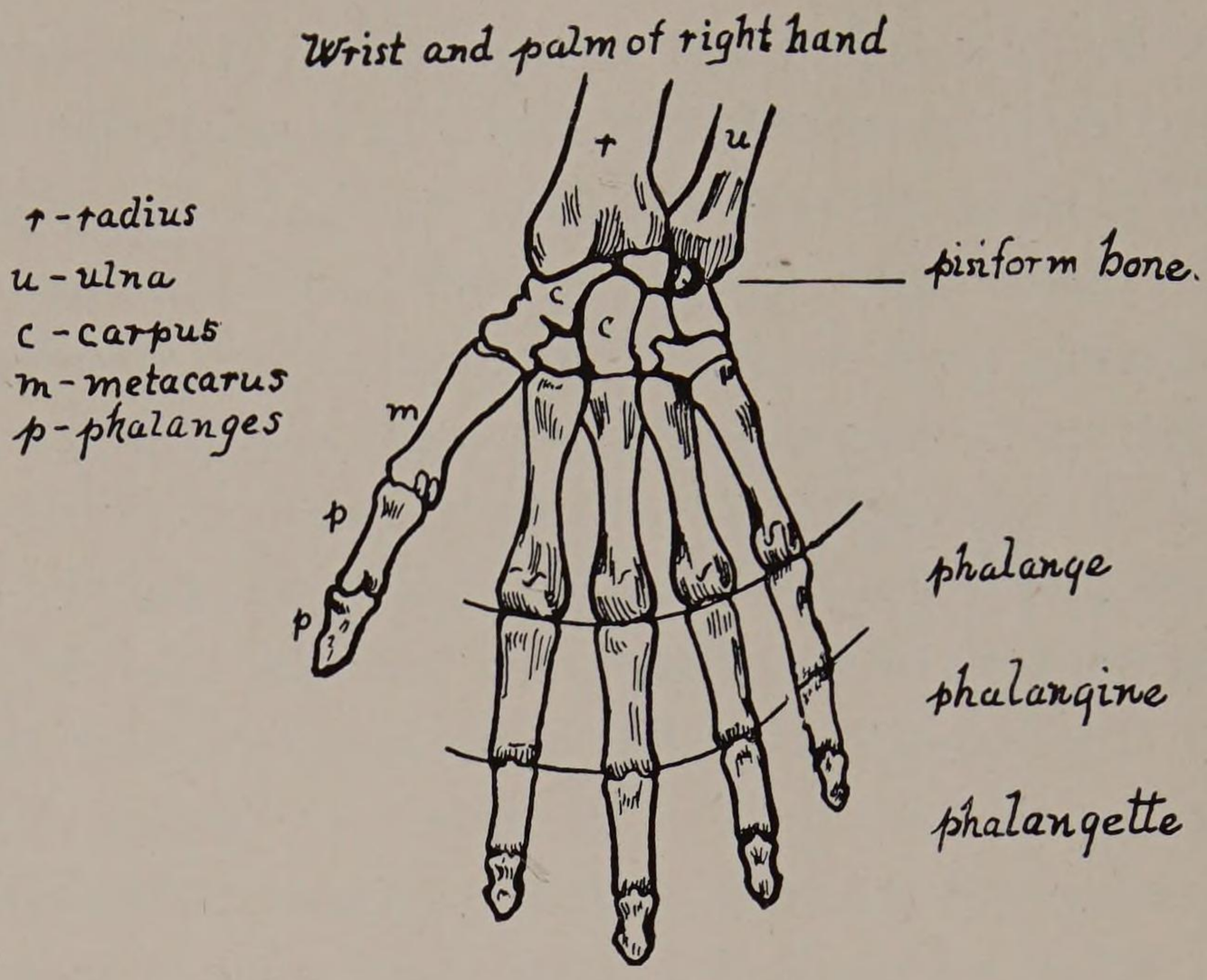


DIAGRAM 33

about the thumb seems necessary here, for it has ways all its own. Through long ages of development as a "tool-holding" agent, it has spread away from the other fingers and in action, opposes them. The angle of the carpal bone to which it is attached, thrusts it out—away from the rest of the hand—and its metacarpal bone is both shorter and stronger than the others. There is also another major difference between thumb and fingers: the thumb has only two phalanges—there is no phalangine, or middle section.

Thigh and Leg—The thighbone, or *femur,* is the longest bone in the human body, and relatively much longer than the femur of most quadrupeds. When man stands erect, the femur is not quite perpendicular, for, as seen from the back, it slants somewhat inward from hip to knee and, as seen from the side, it slants somewhat backward to the knee (Diagrams 34, 35). The general resemblance between humerus and femur is at once apparent. Each has an upper head which rotates in a socket, a long shaft, and a lower extremity which widens into two condyles. But their directions are reversed. The elbow flexes forward, while the knee flexes backward, so that the back of the arm corresponds with the front of the thigh. The upper end of the femur is most distinctive: not only has it a very round, smooth head which fits snugly into the pelvic socket, but there is a "neck" connecting this head with the main shaft. This neck slants outward, downward and slightly backward, terminating in a rough protuberance called the *great trochanter.* This trochanter marks the greatest width of

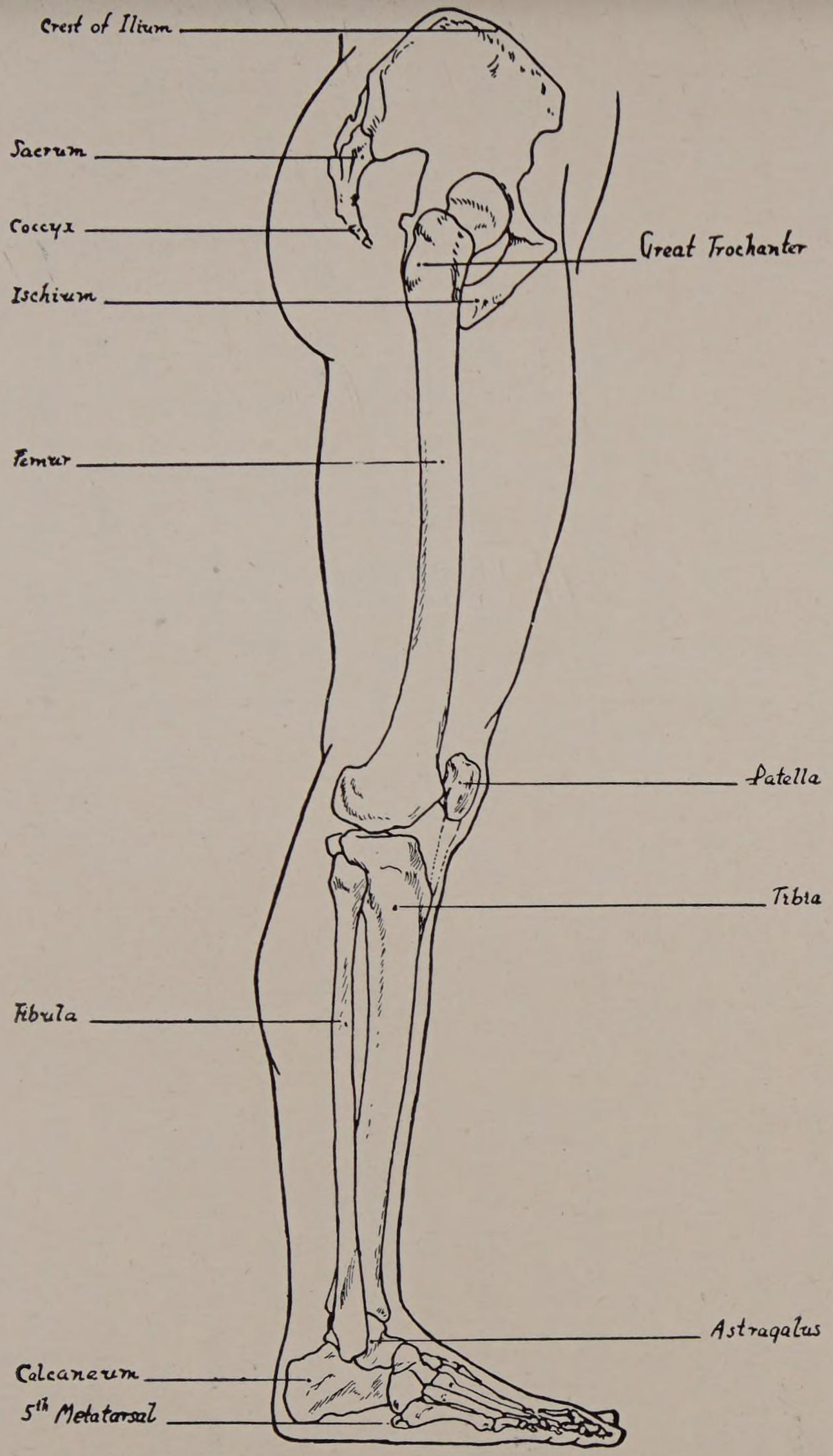


DIAGRAM 34

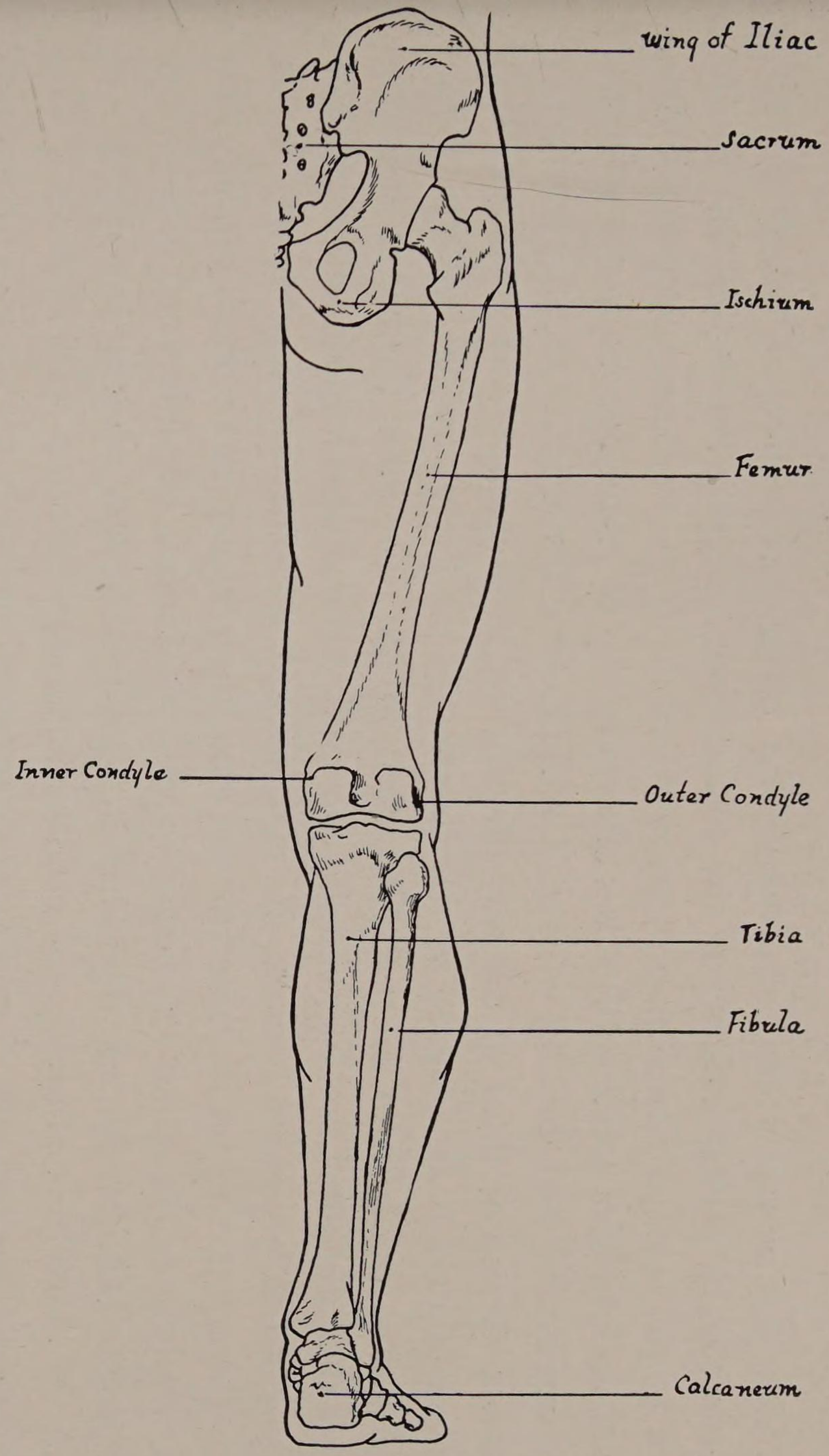
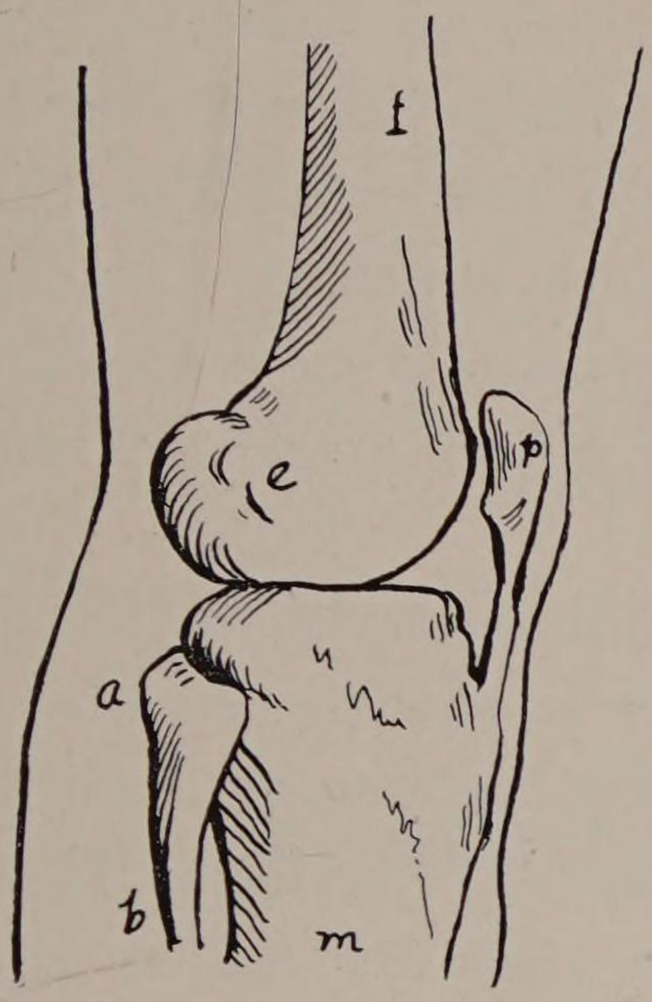


DIAGRAM 35

the hips. It is most important structurally and, being close to the skin and not covered by muscles, is plainly evident on the surface form. Slightly below this and on the back of the shaft is a smaller projection called the *lesser trochanter.* Important ligaments and muscles attach to this, but otherwise it is of minor interest to the sculptor, as it lies buried far below the surface. The shaft of the femur is not straight but curves forward about one third of the way down, then back again toward the knee. This backward curve is accentuated by the direction of the great condyles, most of whose articulating surface is in the rear (Diagrams 34, 35). The inner condyle is distinctly larger than the outer, and between the two we find the same sort of smooth, spool-like surface which we noted between the condyles of the elbow. What we do *not* find is a development, such as characterizes the ulna, for grasping this smooth surface. The two condyles of the femur rest directly upon the flattened, tablelike head of the *tibia,* the larger bone of the leg. The knee is built for strength whereas the elbow was built for flexibility, allowing for pronation and supination as well as flexion. The two bones of the leg—tibia and *fibula*—never cross; the knee's one action is flexion and extension. Where in the forearm we find the two bones dividing their work between them, in the leg we see the sturdy tibia doing all the work at both ends, while slender fibula is hardly more than a convenience for the attachment of muscles. There is, however, another bone in the knee joint which may be regarded as comparable to the olecranon, or upper end of the ulna. That is the *patella,* or kneecap. This roundish little bone lies in front of the knee between the two condyles of the femur and just above the joint. It is attached, not to the femur, but by an inelastic ligament to a roughened projection on the front of the tibia, just below its tablehead. Imagine for a moment that this ligament is also bone and we have almost a counterpart of the elbow, with the patella, instead of the olecranon, slipping smoothly over the hollow between the condyles. For, whenever the leg is flexed or extended, the patella moves with the tibia. Diagram 36 gives us several views of the knee joint. Notice in A and D how the condyles of the femur thrust backward in the standing pose and how, when the knee is flexed in the sitting pose, the rear surfaces of those condyles are now resting upon the top of the tibia, while the patella remains in exactly the same relation to the tibia. In front, the shaft of the tibia forms a slightly curved ridge which, being uncovered by muscle along its inner surface, lies close under the skin of the leg. Too marked a curve suggests "bowlegs," but even on normal legs it should be plainly in evidence.

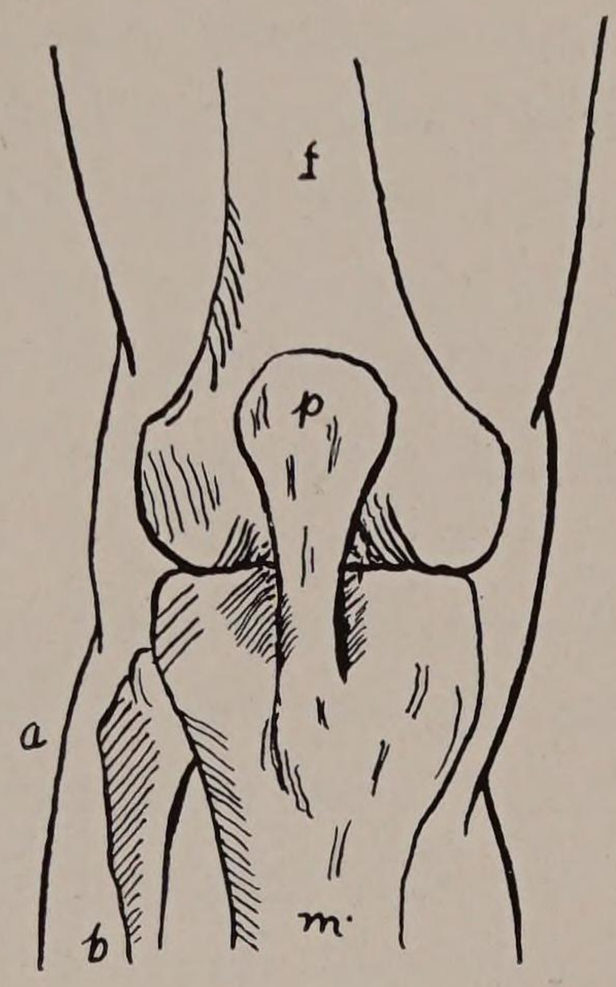
The right knee extended

A



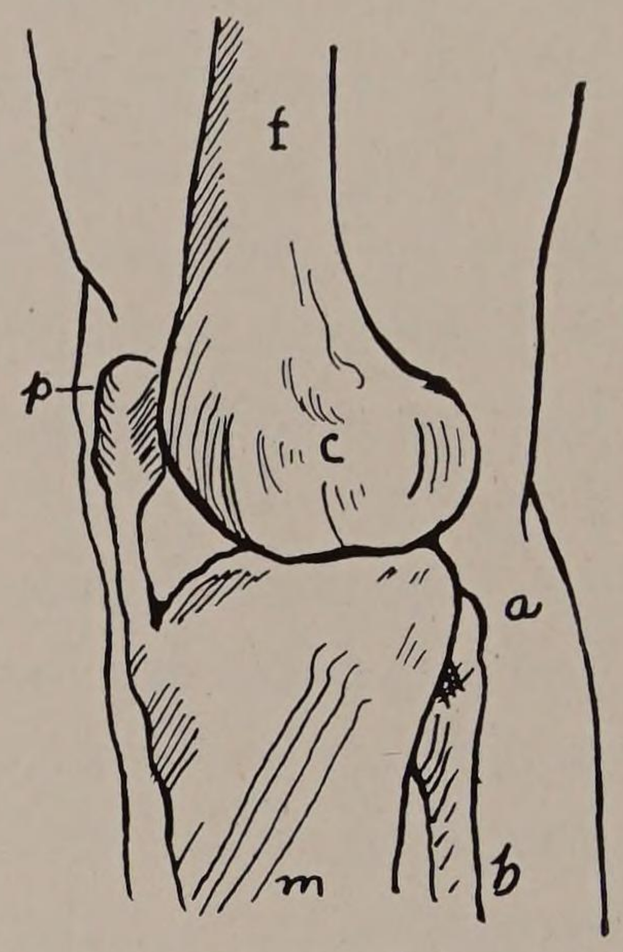
outer side

B



front

C

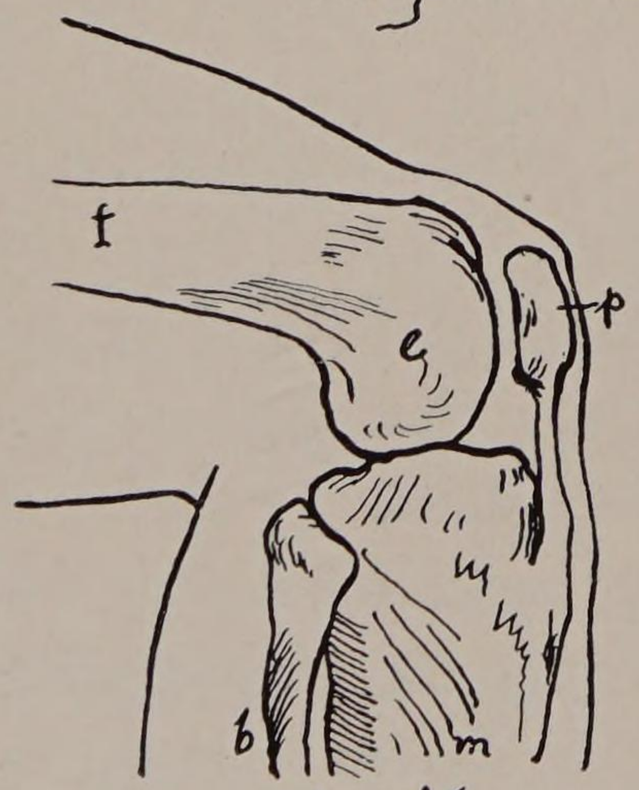


inner side

f - femur
b - fibula
p - patella
m - tibia
a - head of fibula
e - outer condyle of femur
c - inner condyle of femur

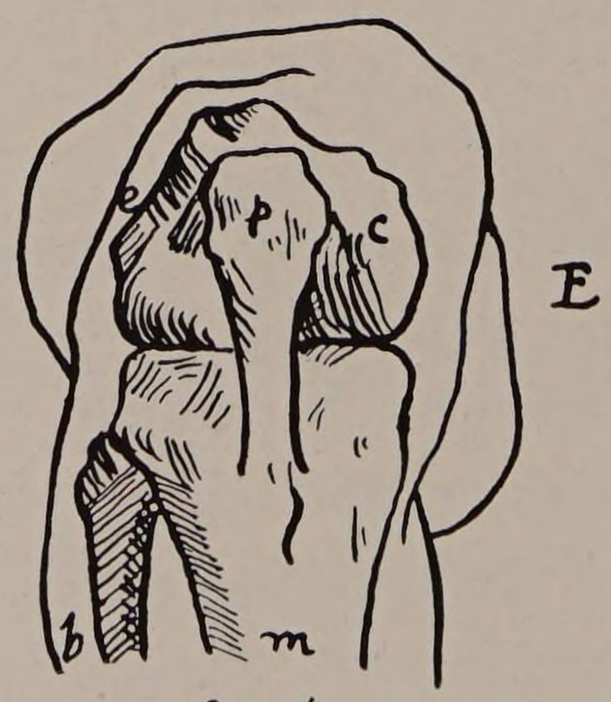
The right knee flexed

D



outer side

E



front

f - femur
m - tibia
b - fibula
e - outer condyle of femur
c - inner condyle of femur
p - patella

DIAGRAM 36

The lower end of the tibia broadens to a head which articulates with the ankle, or *tarsus,* the inner portion of this head forming the inner anklebone. The upper end of the fibula, the smaller of the two leg bones, does not enter into the knee joint at all, but is inserted at the outer side of the tibial head, nearer the back than the front of the leg. As the two bones are of equal length, it follows that the other end of the fibula is lower than that of the tibia, so the outer anklebone is definitely lower than the inner and lies behind it (Diagram 35). This is an important point to remember, for nothing makes a leg look more wooden than having both anklebones on a level.

The tarsus is composed of seven bones, larger than those of the carpus, but fitted and bound together in much the same way and, like those of the wrist, giving elasticity to the joint between leg and foot. The two most important tarsal bones are the *astragalus,* upon which the end of the tibia rests, and the *calcaneum,* or heelbone. The astragalus has a rather "saddle-shaped" upper surface, over which the end of the tibia slides back and forth as the foot is raised or lowered. Its lower surface rests upon the anterior portion of the calcaneum, the rest of which projects backward and slightly downward (Diagrams 34 and 37A). In Diagram 37A you will note that these two bones do not lie directly one above the other, but that astragalus lies more on the inner side, while calcaneum is more on the outer side of the rear part of the foot.

Next to these in importance is the *scaphoid,* forming the inner and higher part of the instep, and welded between these three bones and the *metatarsus* are four smaller bones, arched in a sort of bridge, and none of them touching the ground as we walk. Metatarsal bones resemble the metacarpals in general, as the phalanges of the toes do those of the fingers, but certain differences should be noted: the fifth metatarsal is longer than any of the others, projecting backward slightly toward the heel on the outer side of the foot. Its rear end rests upon the ground, unlike those of the other metatarsals which arch upward, forming the instep. From the heel forward, the fifth metatarsal is the only bone which touches the ground until we come to the ball of the foot—where the metatarsals and phalanges join. The foot spreads and flattens here, forced down by the weight of the body above, so that the "knuckles" of the foot are indicated by a concave surface, from which the phalanges again spring up, touching the ground again only at the tips; that is, the phalanges of the lesser toes do. The great toe, lacking a phalange, like the thumb, presses closer to the ground, with only its tip

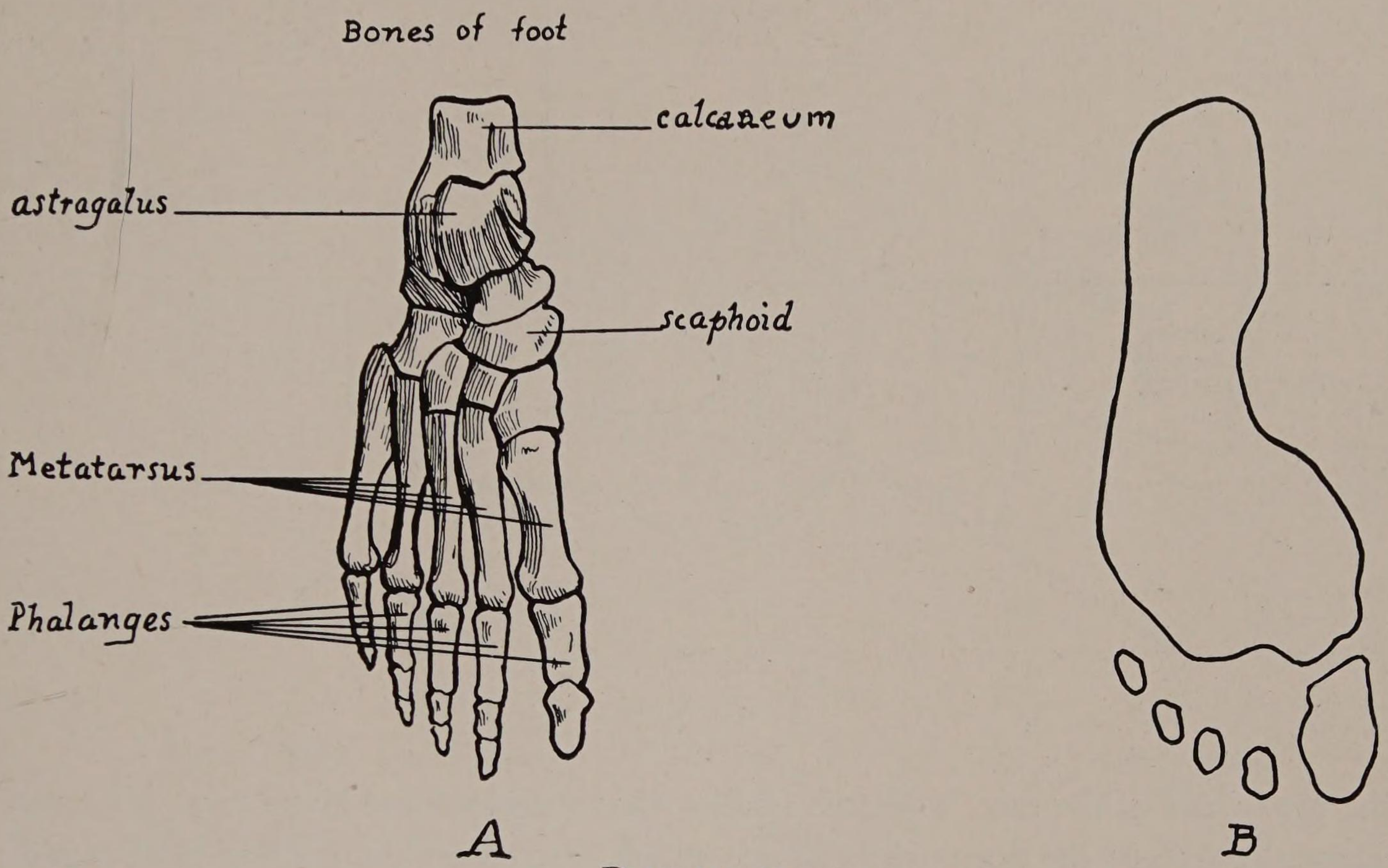


DIAGRAM 37

turning upward. This toe, though definitely separated from the others, is not thrust out at any such angle as is the thumb. The inner edge of the foot is, or should be, almost straight. Diagram 37B, the imprint of a foot, makes clear what parts of a well-shaped foot actually rest upon the floor. Beginners are apt to minimize the strength and backward projection of the heel and set all the foot in front of the leg, but if you note the profile foot in Diagram 34 you will see that at least one fourth of the length lies *behind* the ankle.

The Skull—The bones of the head divide themselves into two distinct groups: first we have the "containing" bones which encase the brain, and collectively form the "cranial box"; secondly, there are the more delicate and irregular bones which form the "skeleton of the face." In rapid sketches the artist is apt to indicate the skull either as a square box, or as a ball. It is, of course, neither, but it suggests both of these geometric forms. From above, the form is distinctly egg-shaped; from the front, it varies from the ovoid to the rectangle, according to the individual; while in profile, it is basically constructed as in Diagram 38, the larger mass representing cranium and

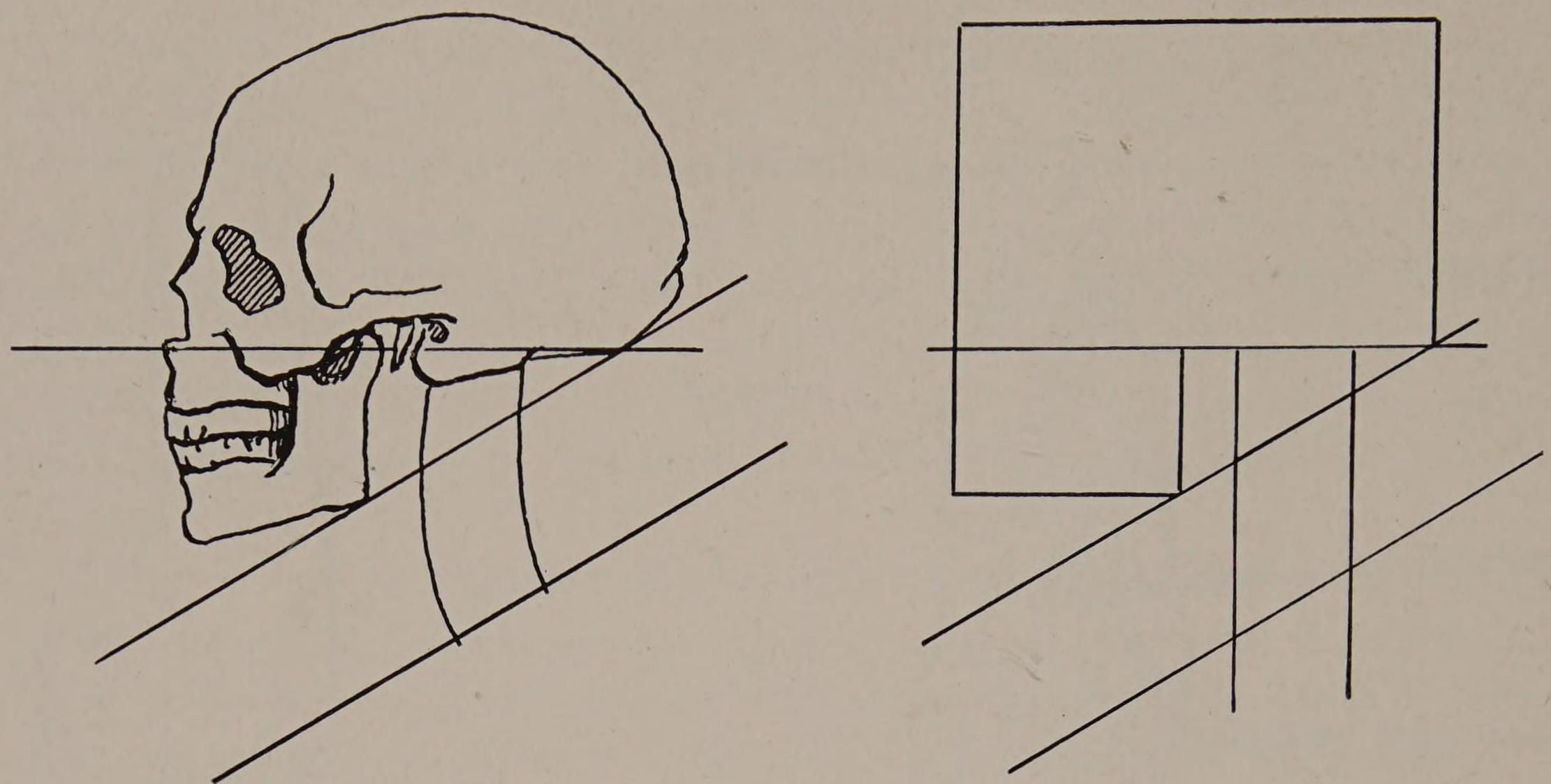


Diagram 38

the upper half of the face, while the smaller mass represents the lower part. We have already spoken of the diagonal directions which characterize the body in profile, and nowhere is this direction more marked than in the head. Note the line from base of skull to the jaw.

The cranial box rests upon the first cervical vertebra. The *occipital* bone, which forms the base of the box, is thick and strong, and through a hole in its under surface the spinal cord passes. As seen from behind, the occipital bone is roughly triangular in shape. It meets the two *parietal* bones which form the major part of the crown of the head, in an irregularly notched seam. These seams between the bones of the head are, in the newborn child, still open, while in the very aged the bones have become so fused and solidified that seams are almost obliterated. In Diagram 39 we see just where these seams lie. The two parietals meet along the top of the head, and their anterior edges join both the single *frontal* bone (forehead) and the two *temporal* bones (temples). The frontal bone forms, with its lower border, the upper half of the two eye sockets; these are usually defined by a pronounced ridge. Just outside this ridge, at the "sunken" part of the temples, the frontal meets the temporal bones, and a small section of what is known as the *sphenoid* bone. This is only partially visible, but it forms the separation, inside the head, between the brain box and the back of the throat. The temporals are the most varied in formation of all the cranial bones, as they contain,

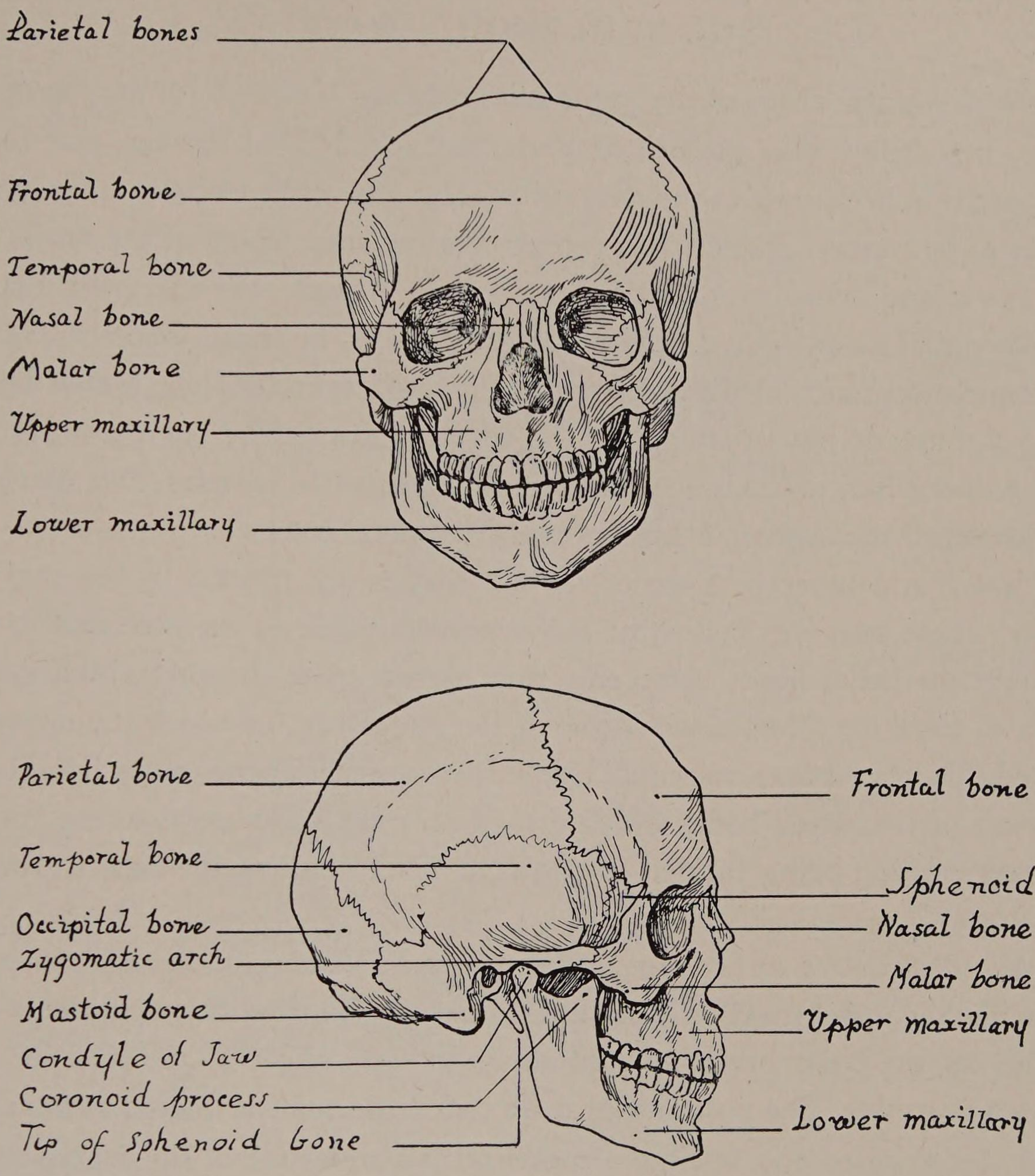

Parietal bones
Frontal bone
Temporal bone
Nasal bone
Malar bone
Upper maxillary
Lower maxillary
Parietal bone
Temporal bone
Occipital bone
Zygomatic arch
Mastoid bone
Condyle of Jaw
Coronoid process
Tip of Sphenoid Bone
Frontal bone
Sphenoid
Nasal bone
Malar bone
Upper maxillary
Lower maxillary
Frontal bone
Parietal bone
Parietal bone
Occipital bone

DIAGRAM 39

not only the prominent ridge of the *zygomatic arch,* which sweeps forward to meet the cheekbone, but, below this, the orifice of the ear and, behind the ear, that rounded lump of porous bone known as the *mastoid process.* The anterior half of the temporal bone tends to be concave, rather than convex like the other bones of the skull.

The lower and outer corners of the eye sockets (which, you will note, are rather square than round) are formed by the two great *malar,* or cheek, bones. Upon these strong prominences much of the character of the face depends. Their rather flattened, projecting surfaces do not lie facing directly forward, but tend to curve away from the front plane of the face toward the side. Here, just below the temples, they narrow to a ridge which meets the zygomatic arch from the temporal bones.

The lower and inner portions of the eye sockets are formed by the two *upper maxillaries.* These start just below the brows on either side of the nose and flare outward to meet the malar bones. After this, they narrow quite abruptly, sinking inward and down to form the "horseshoe" curve of the upper jaw, in which the upper teeth are inserted. The two bones meet just below the nose, under the upper lip. The nose itself consists of two small bones which extend only from the brows to the "bridge," all the lower portion being formed of cartilage. The orifice of the nose is triangular in shape.

The *lower maxillary,* or jawbone, is the only movable bone in the skull. Its anterior portion is, like the upper maxillaries, shaped rather like a horseshoe, but at the posterior ends of this arc the bone thrusts upward almost at right angles to the chin and terminates in two processes. The posterior of these two projections is known as the *condyle* of the jaw. Its rounded end fits into a socket on the underside of the zygomatic arch, forming the "hinge" on which the jaw moves as it opens and closes. The anterior projection, flatter and deeper below the surface, is called the *coronoid process.*

To sum up: The occipital, the two parietal, the two temporal, the frontal bones and the all-but-invisible sphenoid bone, form the cranial box. The two malar, the two nasal, the two upper maxillaries and the lower maxillary form the skeleton of the face.

Now there is one other small bone which has not yet been touched upon. Indeed, many people are unaware of its existence. It lies at the front of the throat, at the angle between chin and neck. Like the maxillaries, but very much smaller, it is shaped like a horseshoe with the two ends curving backward. It is movable, as it is not attached to any other bone. It moves slightly every time we swallow. It serves three purposes: first, to hold in place the tongue, the roots of which attach to it; second, to support the tubes

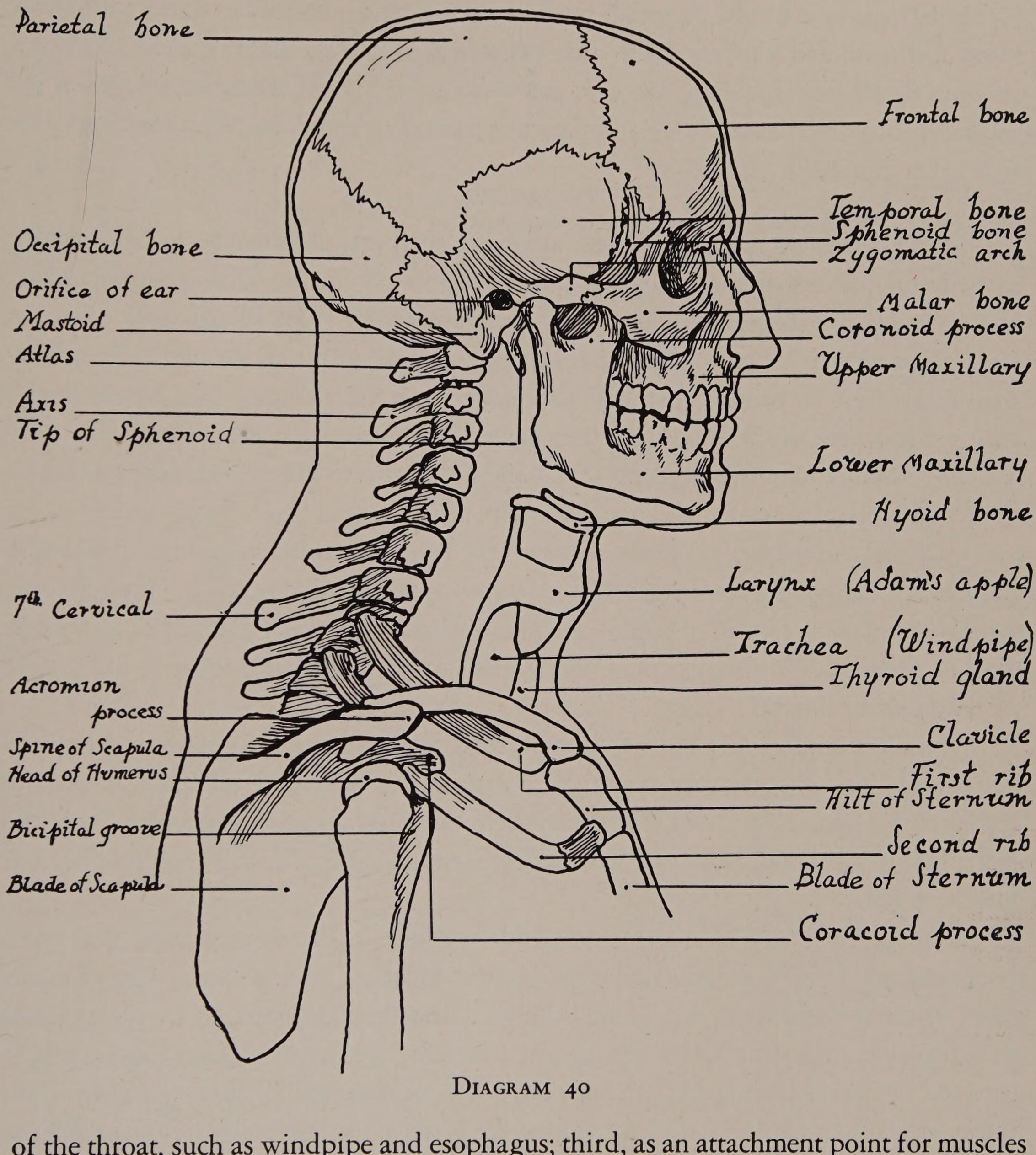


DIAGRAM 40

of the throat, such as windpipe and esophagus; third, as an attachment point for muscles which open the mouth, pulling down from the chin. It has little effect on the surface form and must not be confused with the "Adam's apple" which lies below it. It is known as the *hyoid* bone (Diagram 40).

If you are so fortunate as to live in a large city where there is a good Museum of

Natural History, it would be worth your while to spend some hours there, comparing some well-mounted skeleton with the knowledge you may have gained from this chapter. Small line drawings can give you but a faint idea of the actual shapes of the various bones and the study of a complete skeleton in some active and natural pose will teach you much.

THE MUSCLES

There is today a marked inclination among sculptors to stress design and pattern in their figures, rather than slavishly reproduce every minute and unco-ordinated bit of detail. Many extremists, indeed, veer away altogether from what nature offers, in their absorption with pure, decorative forms. It seems to me that many such, praiseworthy as their intentions may be, have gone so far afield that, like Maeterlinck's children in search of the Blue Bird, they have missed what lay right before them.

For instance: Study Diagrams 41, 42 and 43, drawn to give the student an idea of the remarkable patterns formed by the muscles of the human body. Surely we have here every element of beautiful design: symmetry, variety, repetition, contrast. We find here every imaginable basic geometric form—square, oval, rectangle, triangle, etc. And with what perfection of engineering at the same time! Each muscle has its specific duty to perform, and each is cunningly devised to perform that duty with the utmost precision and economy.

Once the student has thoroughly absorbed the fundamental beauty and logic of these body patterns, he may begin, by stressing this part and minimizing that, to interpret the human figure in the manner best suited to convey his message. But if he starts being "original" before he has mastered nature's laws, he will soon find himself utterly at sea.

During our study of man's framework we have realized, of course, that mere bones, no matter how skillfully adapted and put together, have no possibility of movement in themselves. They are "dead" things unless there are muscles to pull them in one direction or another. Muscles, to put it briefly, are *meat*—fibrous tissues which, directed by nerves from the brain, have the power of contracting and expanding. Their function is to act upon the skeleton and make it move. Muscles vary in size and shape but they all have this in common: when they contract, they act. Throughout the body we find that for every muscle which, by contracting, draws a bone in one direction, there is an opposing muscle which draws it in the opposite. For example, if you double your body forward, bringing head and knees together, you can feel the muscles of your

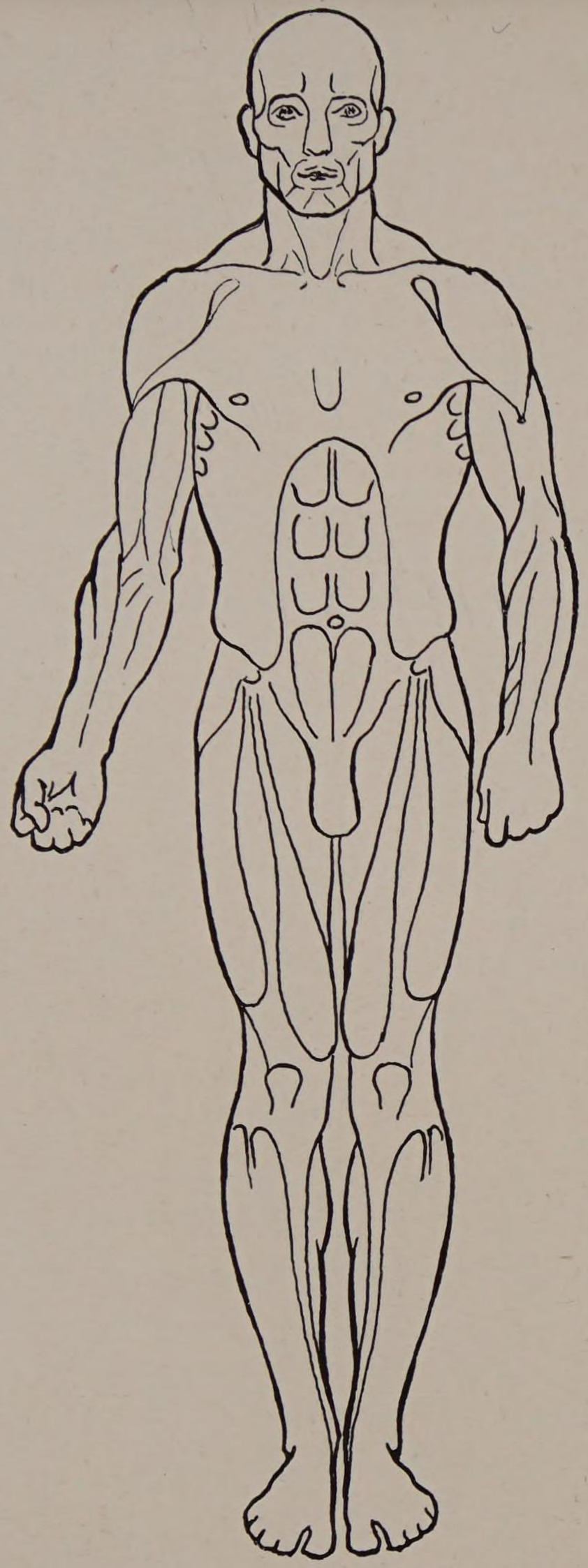


Diagram 41

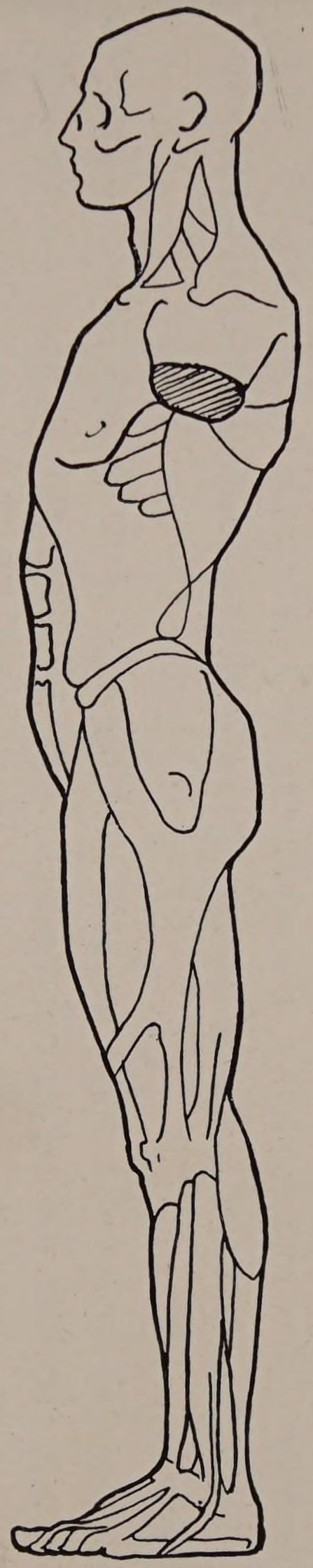


Diagram 42

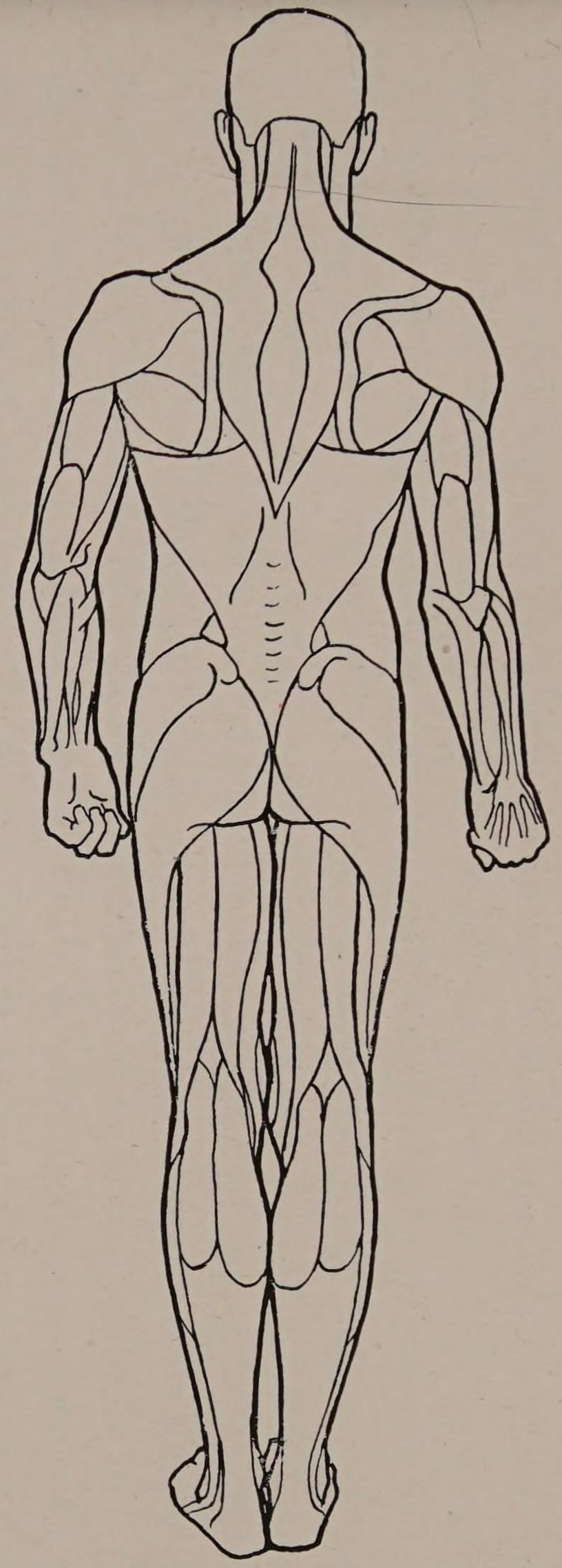
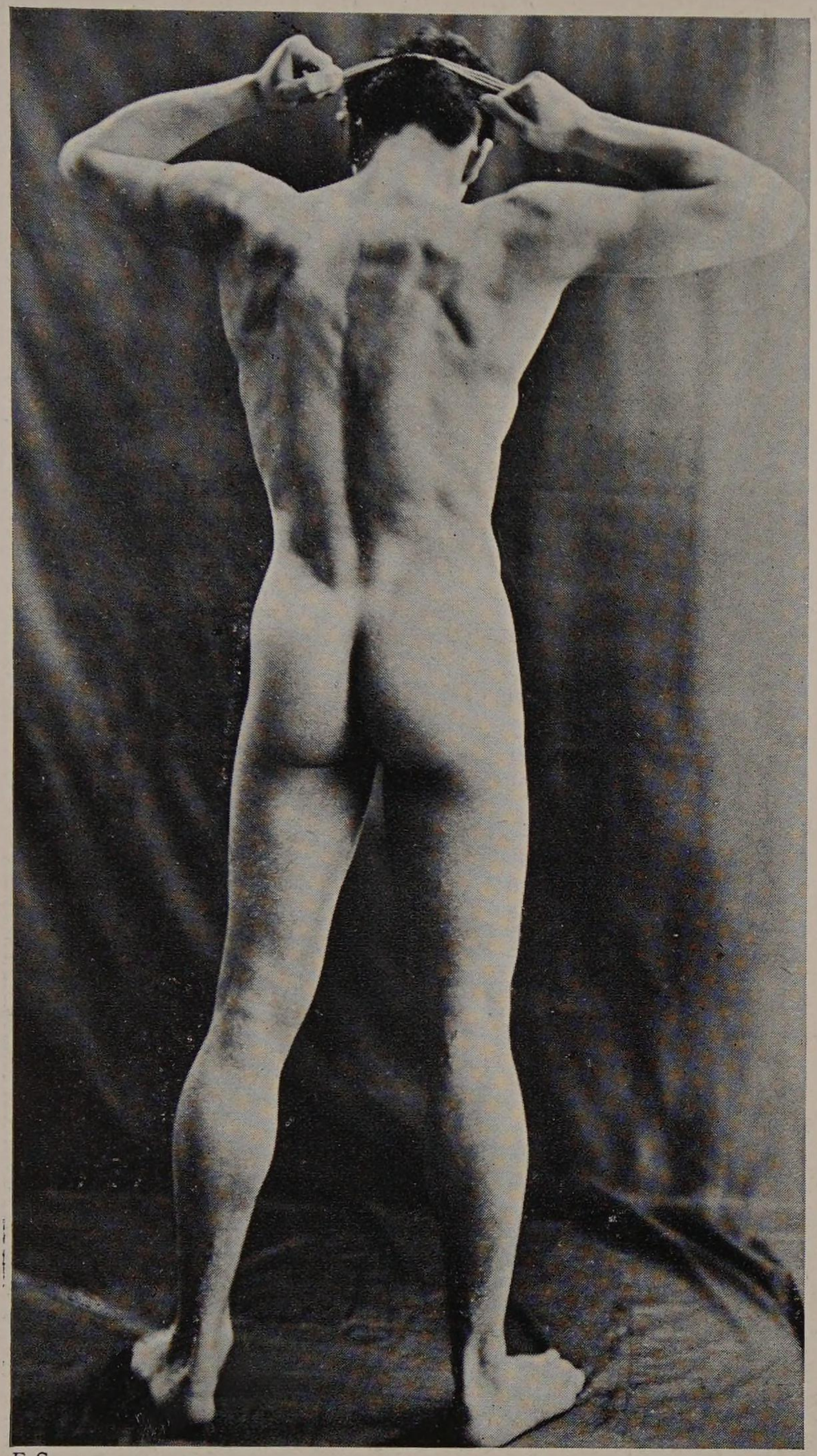


Diagram 43

abdomen contracting to accomplish this. Now, if you straighten up and bend your body backward as far as possible, you will feel the muscles in the small of your back contract, while the abdominal muscles are stretched to their fullest extent. In every part of the body this marvelous interchange is to be found, and the sculptor, especially, must understand just what muscles are acting, and what are not, in any given pose. For a muscle contracted has a very different shape from one that is relaxed or extended. The small boy proudly demonstrating his biceps muscles, contracts them, thereby flexing his arm, and the muscles are seen to shorten and thicken as he does so.

All muscles grow in pairs. Nowhere in the body is there such a thing as a single muscle. Some anatomists refer to those on the shoulders as the trapezius muscle, but there are actually two of them. Likewise when the early anatomists studied the face of a "skinned" man and saw there three ring-muscles—one around each eye and one around the mouth—they linked the three together by calling all three *orbicularis*. As a matter of fact, the muscle around the mouth is quite different from the other two, and is a *sphincter* muscle, the twin of which lies at the other end of the alimentary canal.

Now, as the spinal column was seen to be the basis of the skeleton, it is only proper for us to consider first of all the muscles which lie along and act upon that column. Glance back at the diagram of the spine (22C), and also at the drawing of a single vertebra (23). On both sides of the spinal column, filling the rectangular spaces on either side of the "buttons," is a strong group of twin muscles extending all the way from the tip of the sacrum to the base of the skull (Diagram 44A). Starting at the tip as a thin tendinous growth, these two masses reach their thickest part along the lumbar vertebrae at the small of the back. As they reach the thorax they become thinner and spread out sideways, with a small portion attaching to each rib. At the neck they again become more compact, and the uppermost groups are inserted, either into the vertebrae of the neck, or into the occipital bone of the skull. These muscles are called the *erectors* of the spine, for their main function is to hold the body erect. They are very powerful muscles and, as we have already noted, they arch the body backward when sharply contracted. Their influence on the surface form is most clearly felt in the lumbar and neck regions. In Diagram 44A we see that the swelling of their masses in the two forward curves of the spine very nearly obliterates these curves. Owing, however, to the shoulder blades and their muscles, and the backward-thrusting curves of the large hip muscles below, the outline of the back of a living model again possesses these well-



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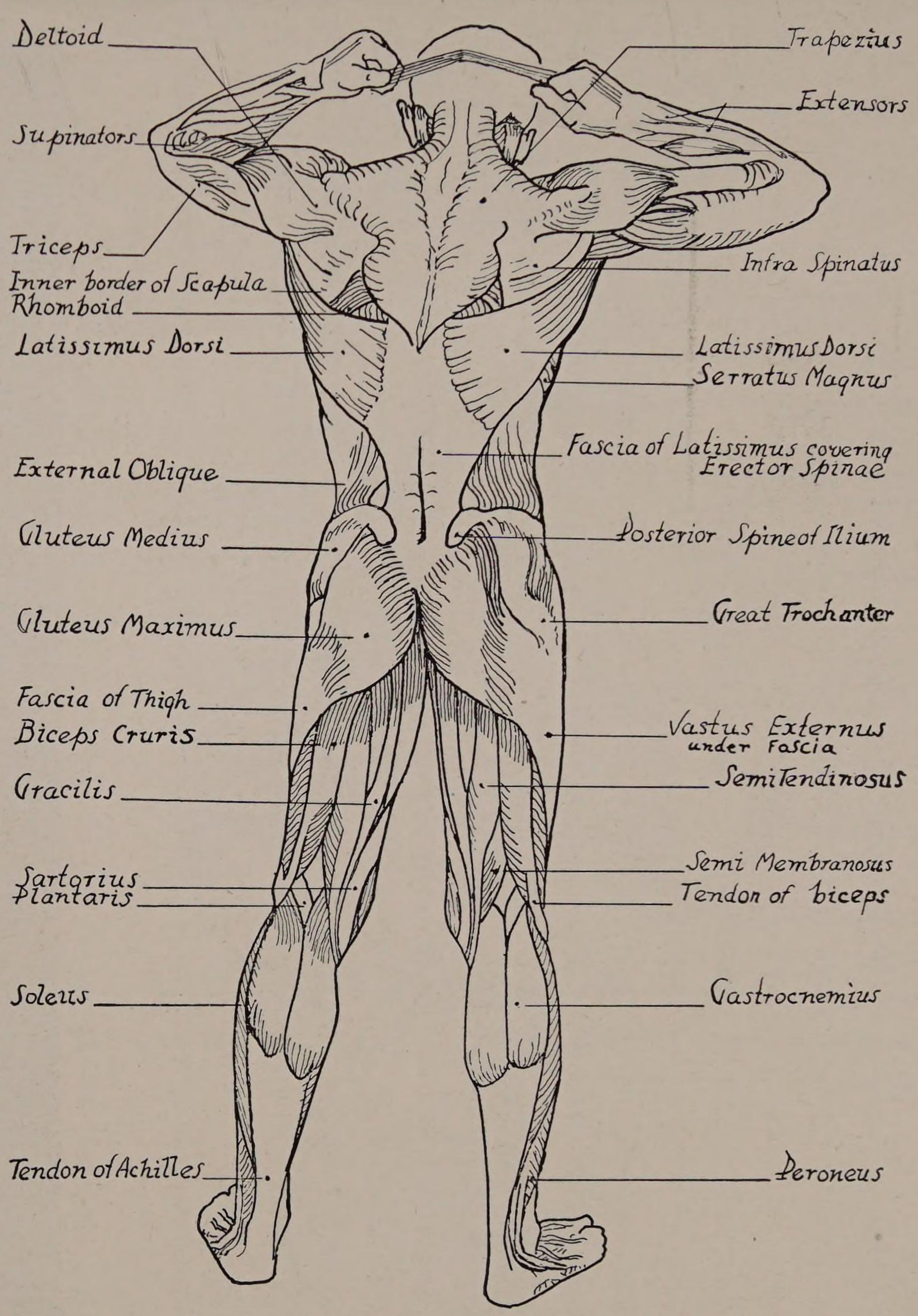
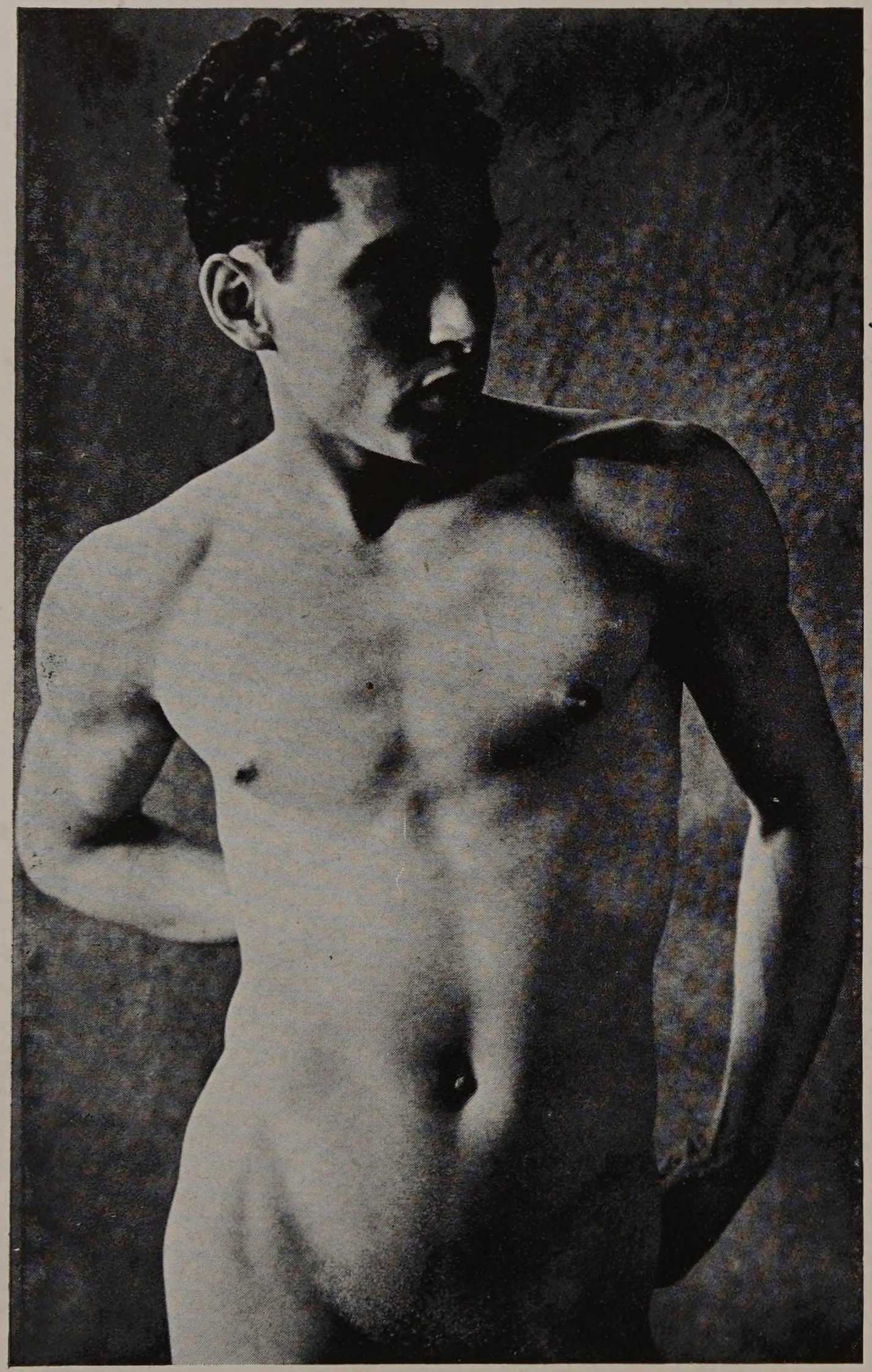


PLATE 58. Man, *Back View*



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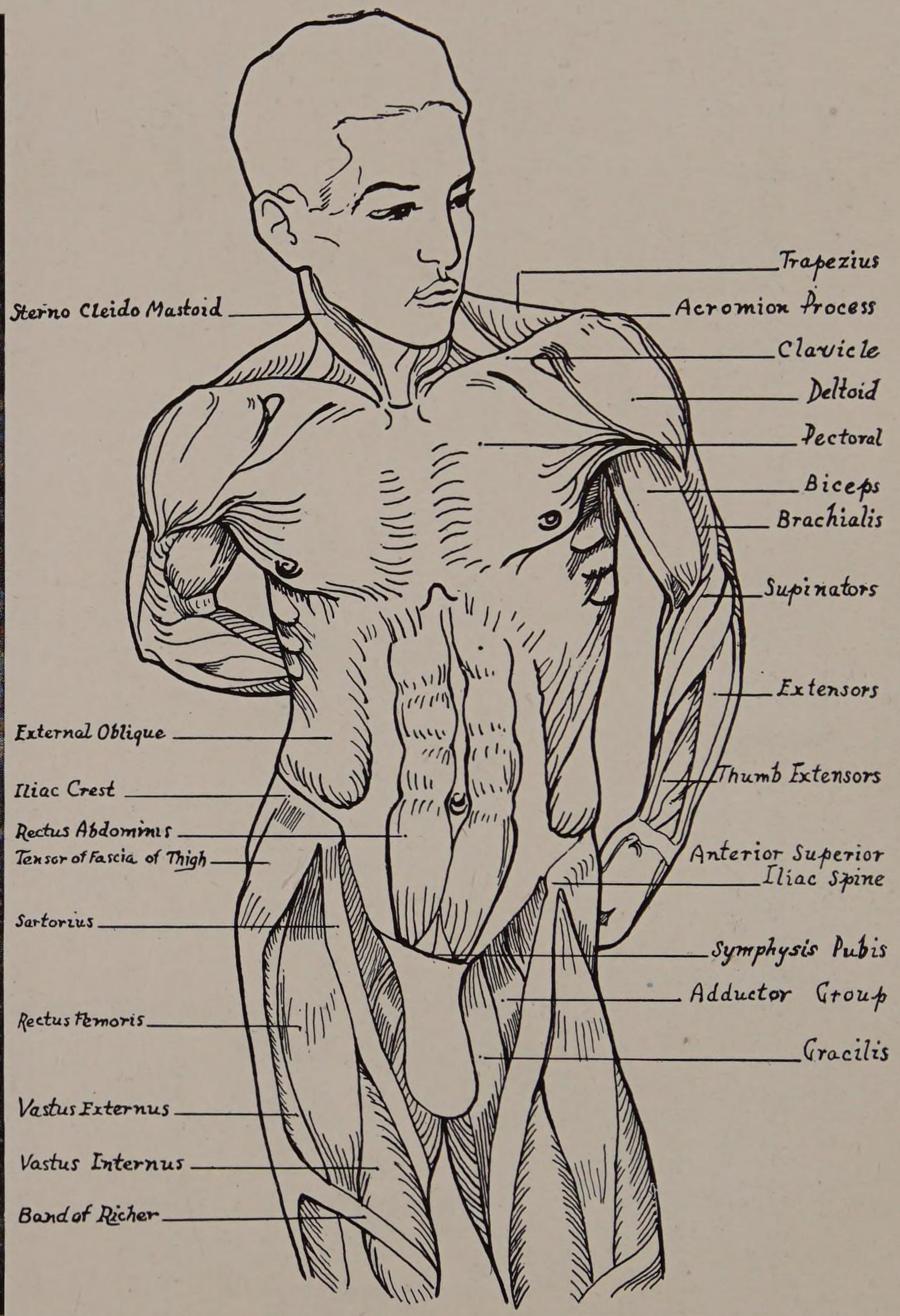
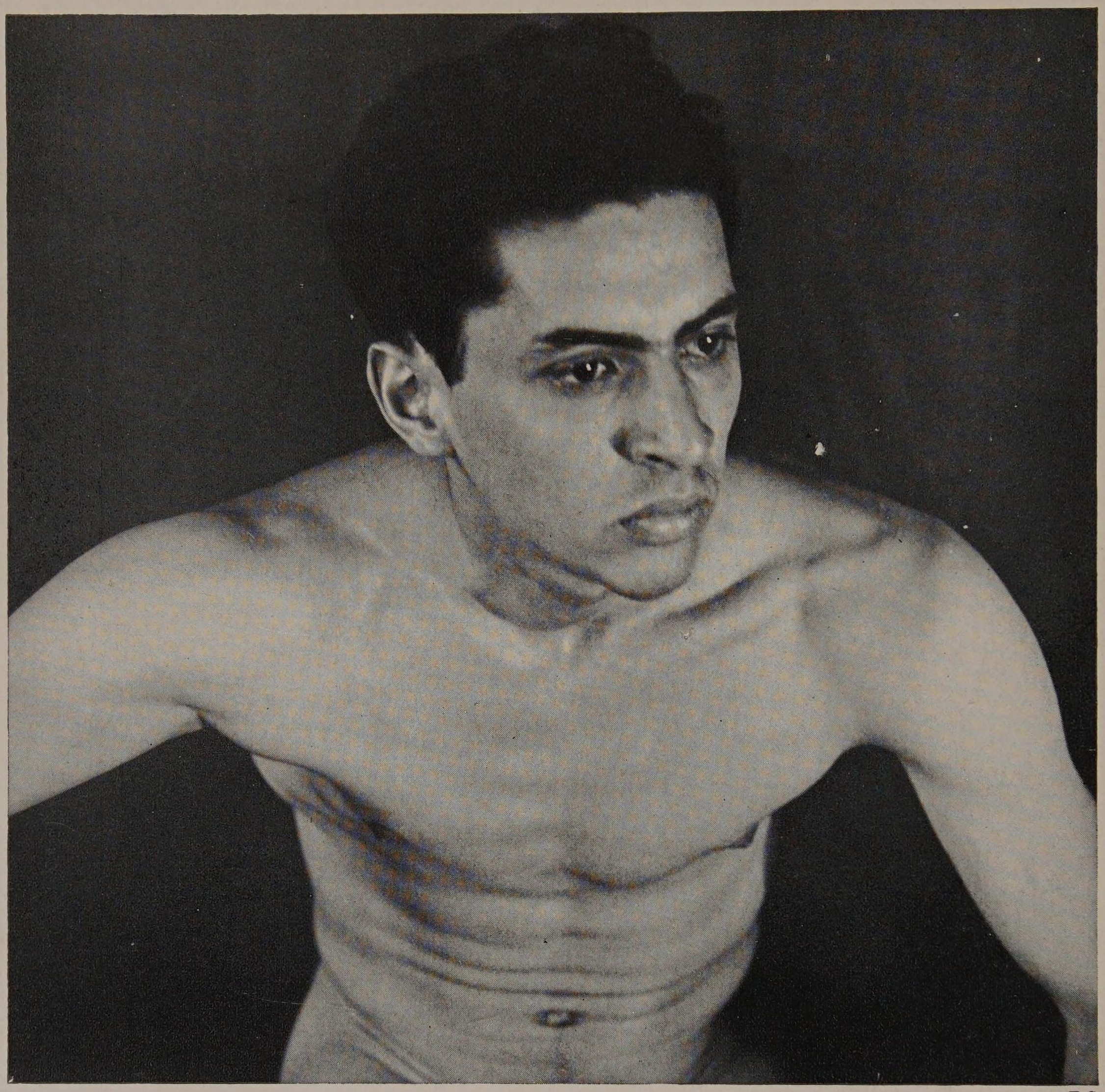


PLATE 59. Man, *Torso*

defined curves. In Plate 58 the two masses of the erectors may be clearly distinguished.

Now let us find what muscles act in opposition to the erectors. Surely they must be situated on the front of the body if they are muscles which double the body forward, drawing thorax and pelvis together. A glance at Plate 59 shows us the *rectus abdominis.* From the very lowest point of the abdomen, symphysis pubis, these muscles pass straight up over the abdomen, attaching to the tip of the sternum and to the cartilage of the seventh ribs. As these muscles lie, not over solid bone, but over the soft viscera which they must hold firmly in place, they are reinforced, as it were, by transverse bands of elastic tissue which divide the perpendicular fibers into four groups. From symphysis to navel is the largest group, the smaller ones lying between navel and thorax. The furrow between the two rectus muscles, known as *linea alba,* marks the center of the body in front, just as the spine marks it in the back; and, no matter what position the torso is in, no matter how bent or twisted, the one has the same direction as the other—linea alba echoing, as it were, the curves of the spine. Plate 60 gives one a clear idea of the manner in which rectus abdominis puckers when it contracts to bend the body forward.

On either side of rectus is a "space," concave on the surface form because it is only a tough, white elastic sheath, called *aponeurosis,* attaching to the two "side" muscles. This aponeurosis extends down either side of the groin to symphysis, but the muscular bodies of the two *external obliques* begin just above the anterior superior iliac spine. Thence they sweep diagonally upward, outward and backward over the lower ribs and around to the side of the body. The lower borders of these muscles follow the line of the iliac crest and swell out above it, so that in the living model that crest is no longer seen as a ridge of bone but as a depression (Plate 61). The upper portions of the external obliques are seen to divide into strips which dovetail with other muscles which wrap around the ribs from the back. Each strip is here inserted into a rib. Therefore we know that they must act like the rectus, in pulling between pelvis and thorax. But, unlike rectus, their fibers are "on the bias." They pull diagonally. Therefore, they not only draw the thorax down, but they twist and turn it. And they act in opposition to each other. If one is contracted, the other is extended. There are, of course, two large muscles on the back which act in opposition to these external obliques but, before studying those, it would be well to find out about the muscles which dovetail with the obliques on either side of the chest wall under the armpits. On the living model (Plate 62) we see only the lower ends of two or three of them, wrapping



E.S.

PLATE 60. Man, *Torso Bending Forward*

around the ribs like fingers. All the rest are covered by other muscles. But these *serratus magnus* muscles form quite a powerful mass. They start from the inner edge and under-surface of each scapula, sweeping around between scapula and thorax and separating into sections, each forward end of which attaches to a rib. Obviously, they specialize in drawing the shoulder blades downward and forward. The student who fails to recognize that these are muscles, not ribs, has a hard time modelling the sides of the

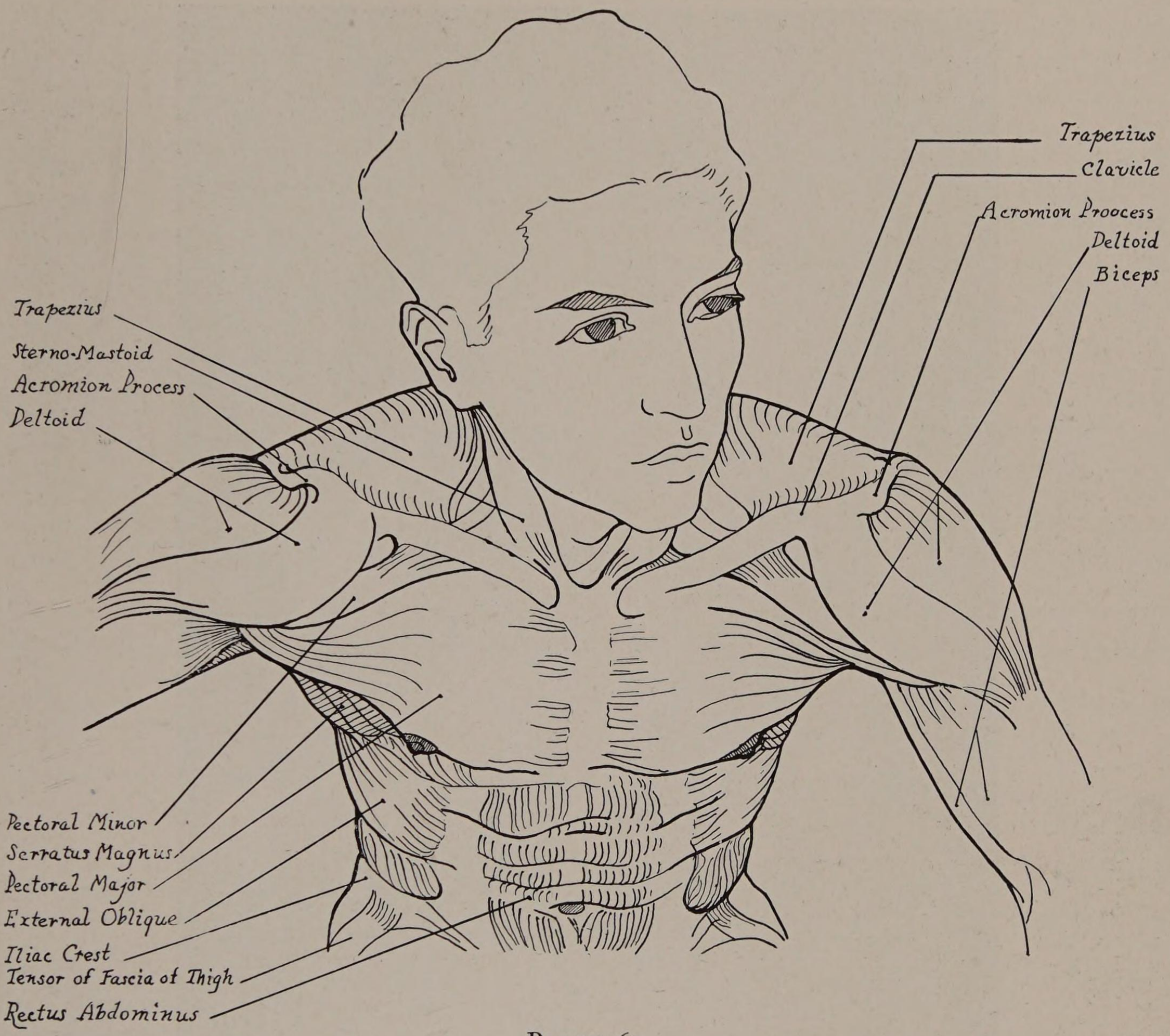
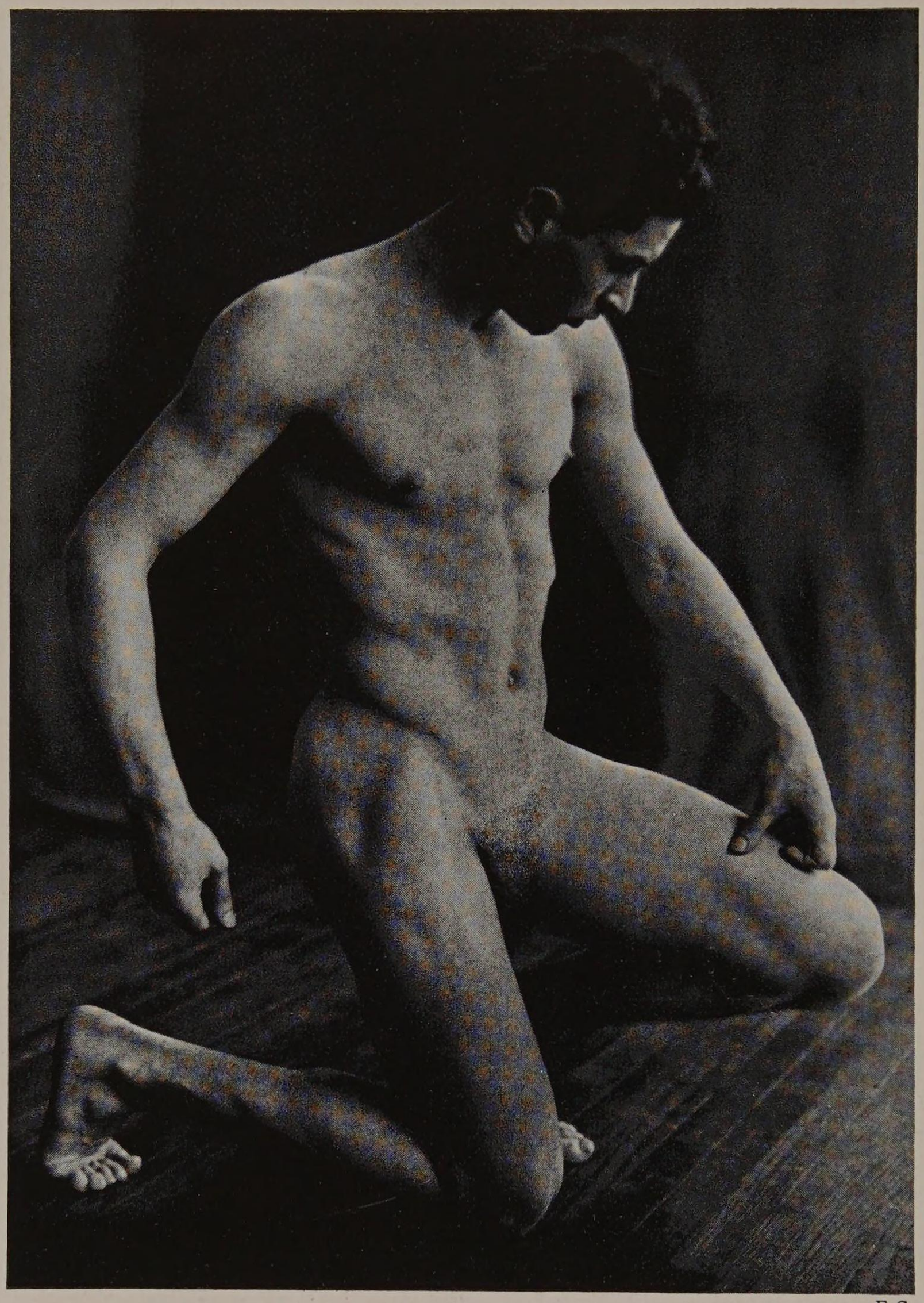


PLATE 60

thorax, and makes no distinction between the convexity of the muscles and the comparative concavity of the flattened ribs themselves. For two reasons we see only a small part of the serratus on the surface; first, because much of them lie under the scapulae; second, because they are partially covered by the two large muscles on the back which are now to be considered.

Turn to any diagram showing the back of the model and you will see, sweeping upward from the sacrum and wrapping forward about the thorax, two expanding muscles called *latissimus dorsi.* These have their origin at the very tip of the sacrum, beginning as an aponeurosis, or flat white tendon, which completely covers the lumbar



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PLATE 61. Man, *Kneeling*

portion of the erector muscles. This aponeurosis extends up the center of the back as far as the sixth dorsal vertebra. The actual muscular bodies of latissimus begin to thicken an inch or so on either side of the median line, the fibers slanting diagonally upward, outward and forward. With a beautiful twist, the fibers converge under the arm and are inserted into the front of the shaft of the humerus. It is this upper portion of the latissimus muscles which overlies a part of the serratus magnus. This part forms

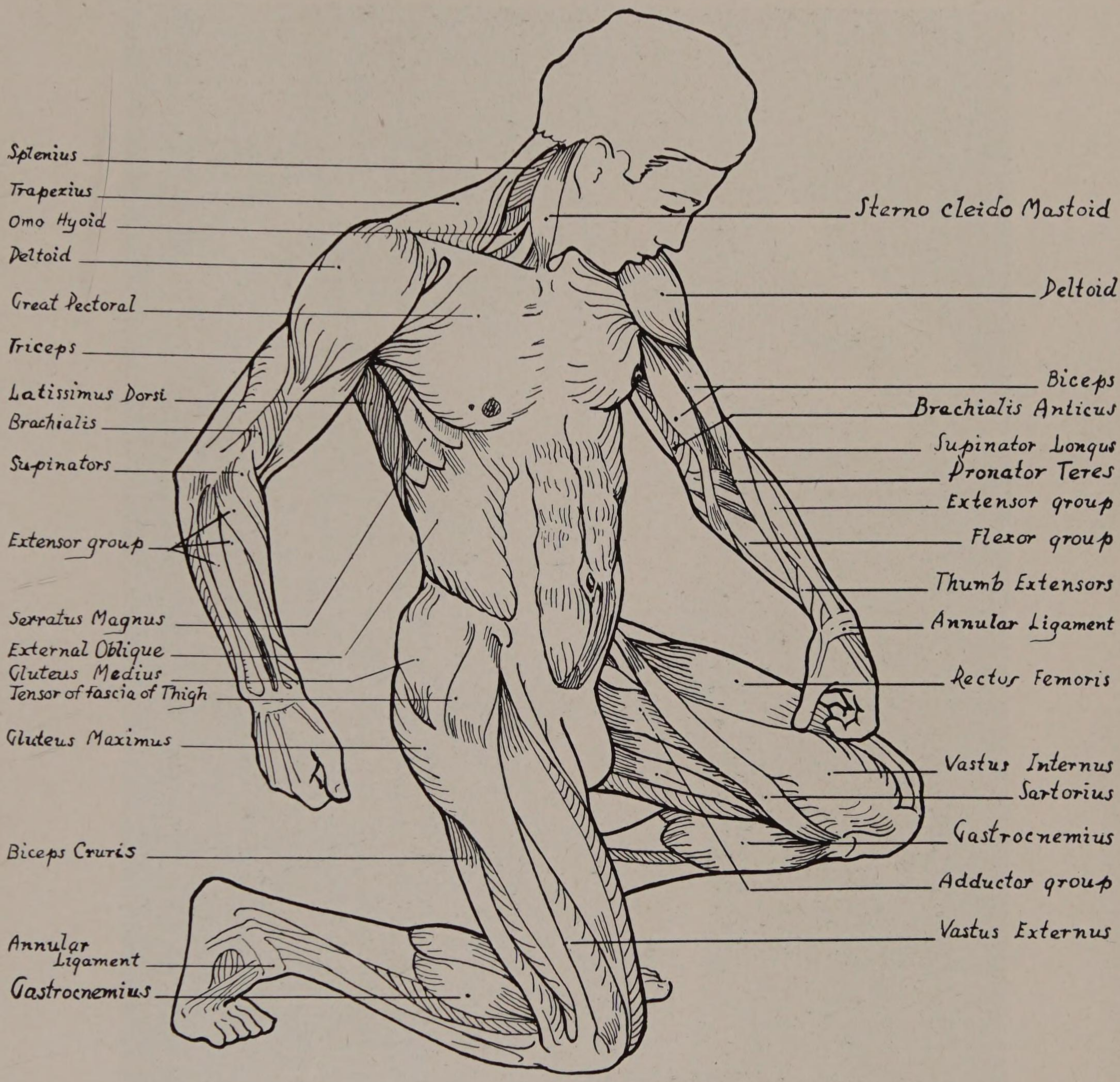
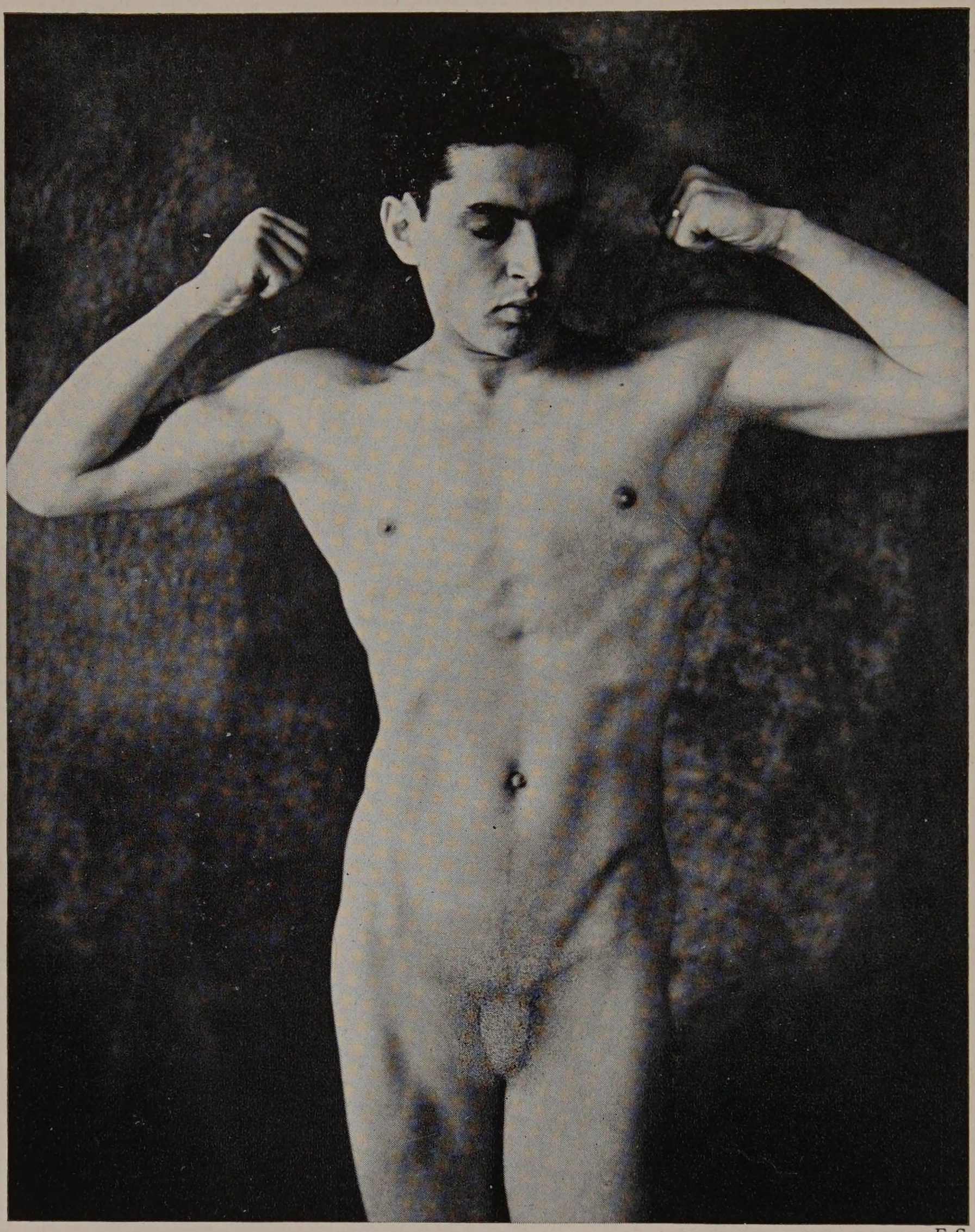


PLATE 61

the posterior boundary of the armpit which, as seen from the front when arms are raised (Plate 62), is much wider than the chest wall and forms a sort of bridge sweeping out from thorax to arm. The latissimus dorsi collaborate with the external obliques, twisting the torso and drawing down the shoulders. Being attached to the arm at their upper ends, they also rotate the arm inward. In such activities as rowing or pulling hard on anything (as in Plate 72), both serratus and latissimus are used with every pull.

Looking at a profile view of the torso, we distinguish the two contrary directions



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PLATE 62. Man, *Torso with Elbows Raised*

of latissimus and external oblique with the smaller serratus peeping out from under latissimus. In Plate 63, we have a fine view of latissimus in action: the left side is drawing arm and shoulder back, while the right side is extended to its fullest by the thrusting arm. At the small of the back, where the aponeurosis of latissimus and external oblique do not quite meet, we always find two small hollows just above the iliac crest. With the two dimples below, formed by the posterior iliac spines, we have

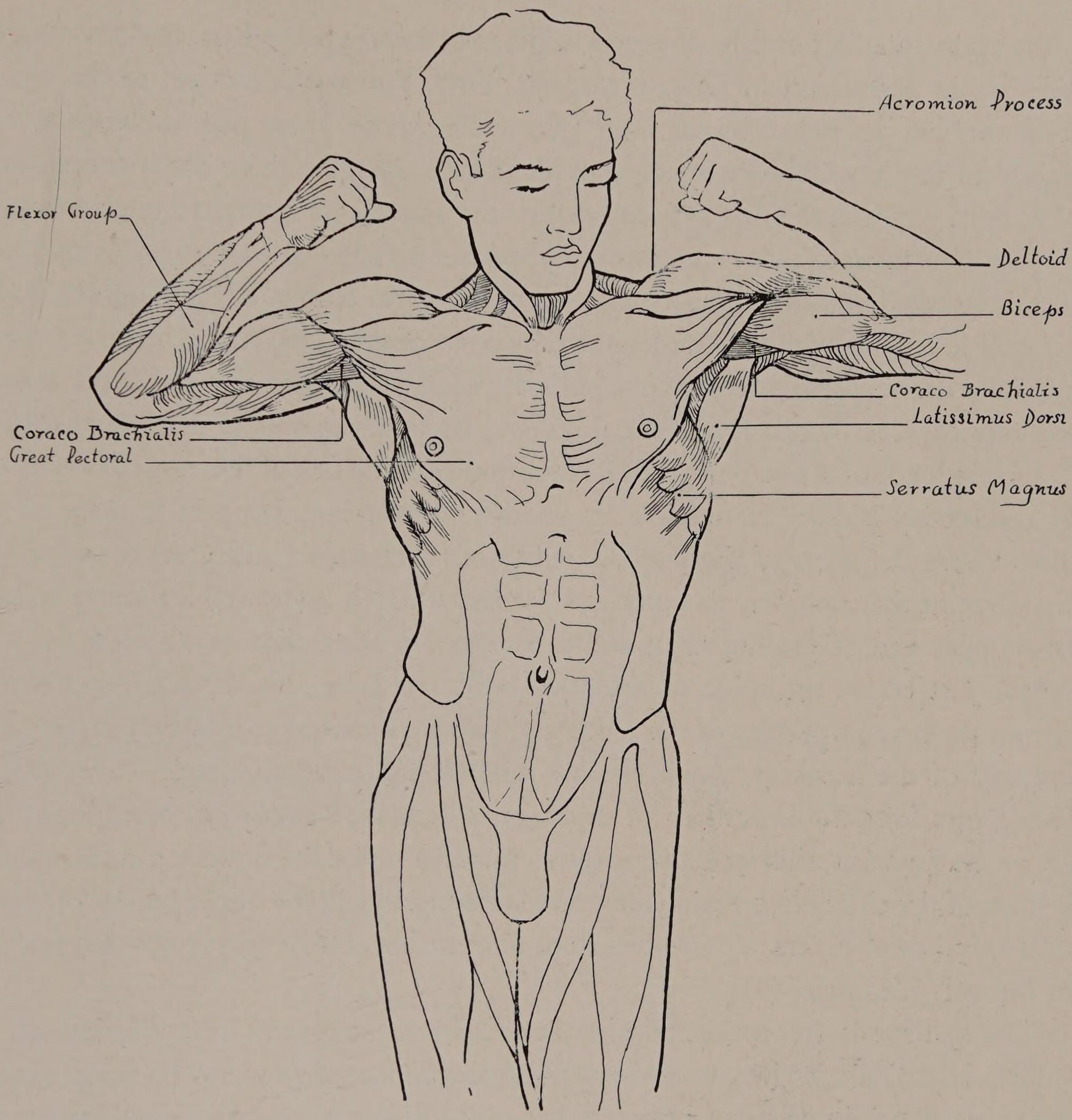


PLATE 62

here a delightful little pattern, which provides a contrast to the broad planes of the back above and the rounded buttocks below.

In serratus magnus we found the muscles which draw the scapula downward and forward. Where shall we find those which draw it up and back again? In Diagram 44B is a muscle called *rhomboid*. Owing to the fact that in nature this muscle is almost completely covered by others, only such a sketch as this shows rhomboid in its entirety.

On the right shoulder and back everything has been stripped off except two muscles which act in opposition to serratus magnus. From the fourth cervical to the fourth dorsal vertebra we see a broad layer of muscle whose fibers pass downward and outward to the inner border of the shoulder blade. Imagine these fibers contracting, and at once you will see that they must draw the scapula both upward and in toward the spine. The upward pull is reinforced by another muscle—*levator anguli scapulae*—which is attached, not to the inner edge, but to the upper corner, of the shoulder blade. This muscle has its origin in the lateral projection of atlas, the first cervical vertebra. It not only draws the shoulder up but pulls the head down sideways. This little muscle is entirely covered by others and the rhomboid itself shows only at the lowest corner.

On the blade of the scapula itself lie four muscles. The first of these—*supra spinatus*—is completely hidden from view by another muscle but, lying as it does in the hollow above the spine of the scapula, it fills out that region and gives roundness to the outline of the shoulder. Its outer end reaches through under the acromion process to the upper end of the humerus, and it thus assists other muscles to draw the arm upward. Just below the spine of the scapula lie the *infra spinatus* and *teres minor,* covering the greater portion of the blade and passing outward to insertion in the great tuberosity of the humerus. Again, below this we find another muscle—*teres major,* which grows from the lower half of the scapula. Instead, however, of attaching to the back of the humerus, this teres major twists forward under the bone and is fastened to the front of the shaft close beside the great latissimus dorsi, the upper border of which touches, and even covers, a part of it. Both teres major and latissimus act to rotate the arm inward (Diagram 45).

The student is frequently puzzled at first by the apparent complication of the shoulder blade muscles but, once they are understood, they prove to be fairly simple. If he raises his right arm and rotates it backward as though he were about to pitch a ball, this is done by the upper three muscles—supra spinatus, infra spinatus and teres minor. Now, if he brings his arm forward and downward, throwing the ball, teres major and latissimus work, rotating the arm forward.

The final muscles of shoulders, back and neck, called *trapezius,* are most interesting in shape. They have often been likened to a kite, though that term does not adequately describe them. They are separated by a central, flat, white aponeurosis which attaches to the vertebrae. The muscles have their origin at the base of the occipital bone, spread out over the tops of the shoulders, are inserted into the acromion process

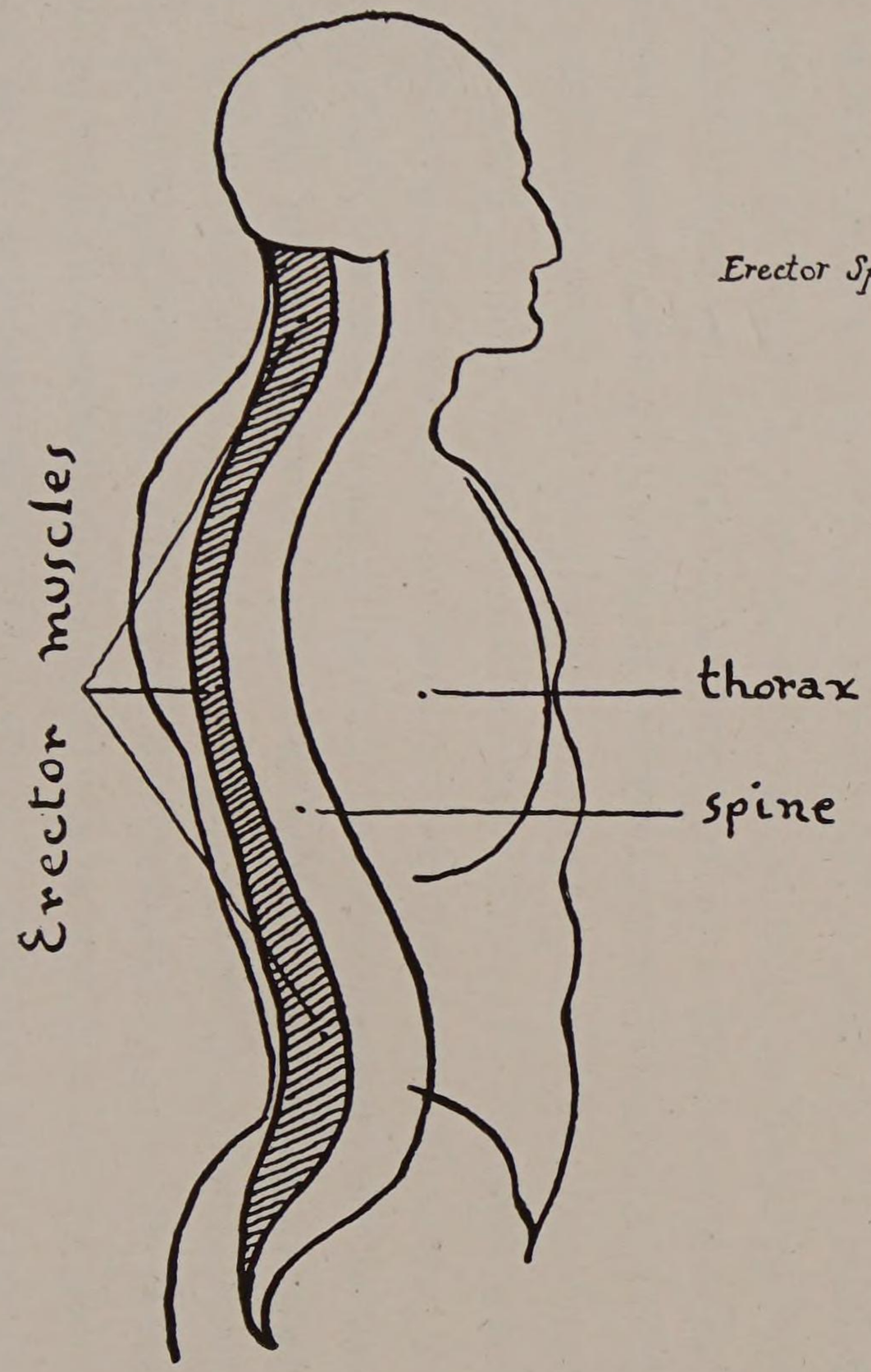


Diagram 44A

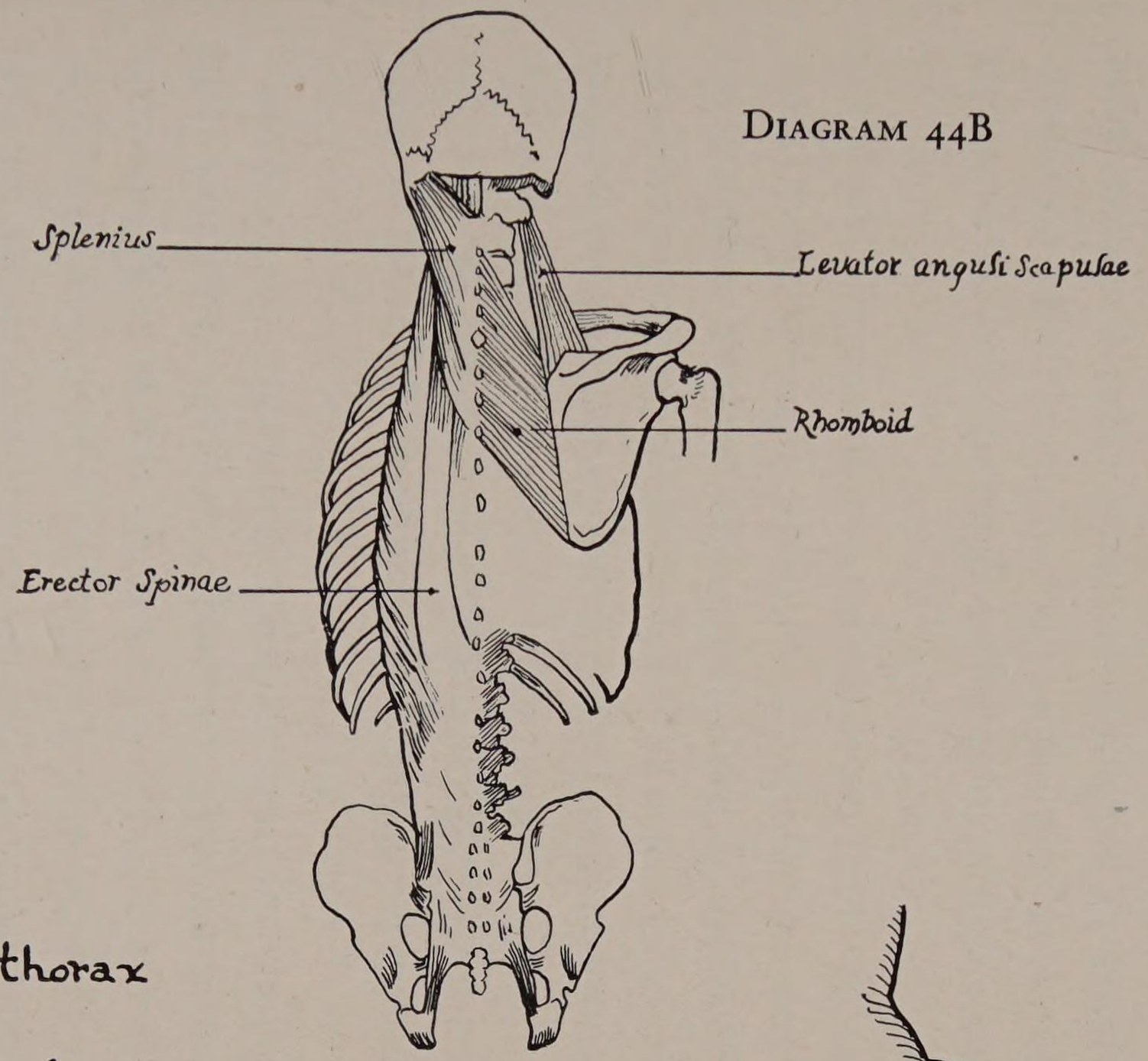


Diagram 44B

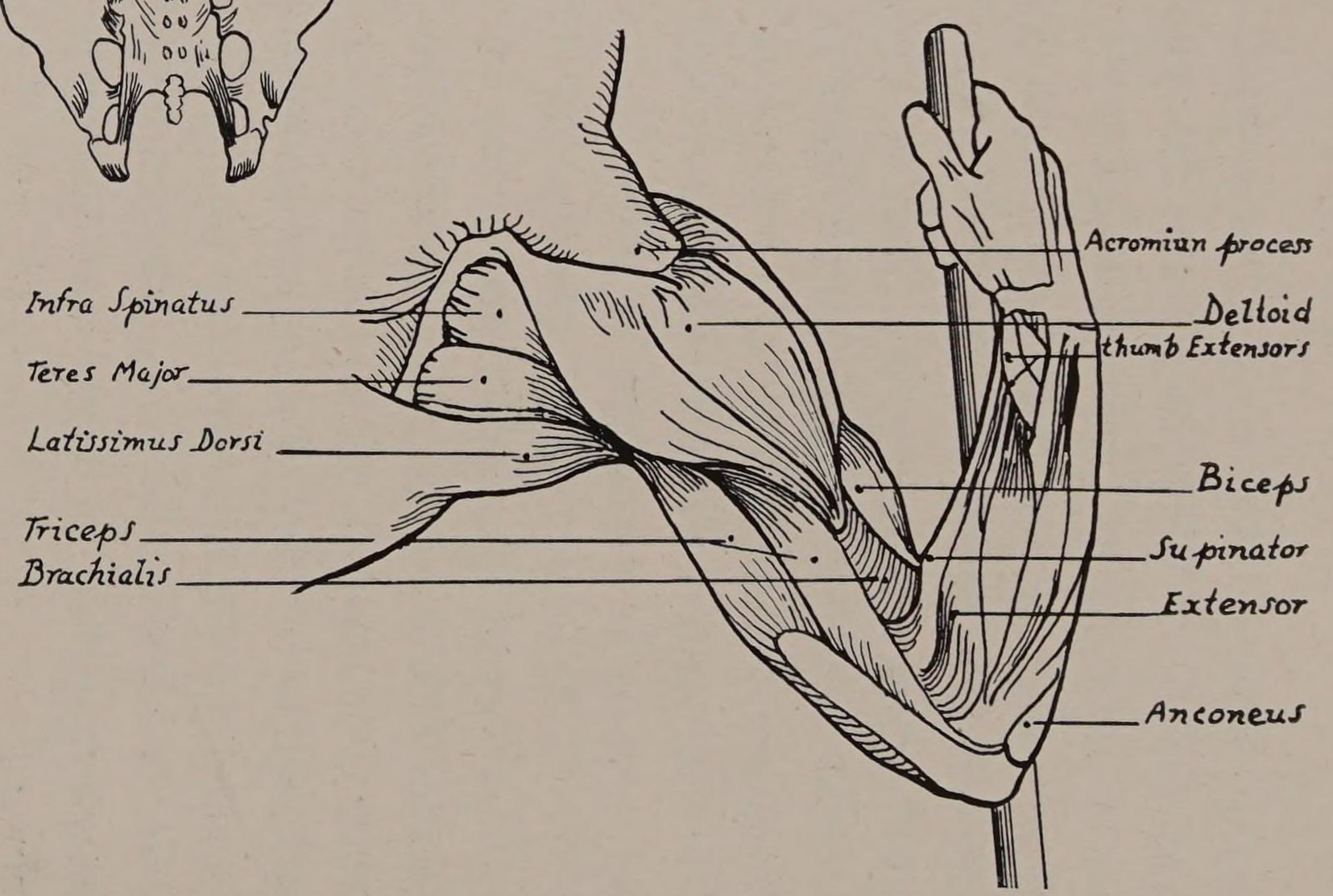


Diagram 45

and the outer third of clavicle, run inward again along the spines of the scapulae, and then down in a V-shaped point to the tenth dorsal vertebra (Plate 63). The point of this V overlaps the upper dorsal insertions of the latissimus muscles. The central aponeurosis is widest around the seventh cervical vertebra, which is one of the reasons why this is so prominent. The two sections which run down the back of the neck are usually most clearly seen on a thin child, or on an old person. They should never be stressed when one is modelling a figure in the prime of life, for the deeper muscles (erectors, splenius, etc.) tend to round out the whole neck in the form of a column. A healthy man or woman should have a strong, rounded neck: stringiness here suggests ill-health or advanced age.

It is the outer "wings" of trapezius which cover the supra spinatus, and the lower "wings" which partially cover rhomboids and erector groups. The action of these muscles is most interesting. Their various sections have different and independent duties. For instance, the upper ends may be sharply contracted, drawing the head far back, while the rest of them are entirely relaxed. One shoulder section may be busy drawing the shoulder girdle up and back, while the other is completely extended. The lower V section may be collaborating with the rhomboids in drawing the scapulae sharply together, while the neck section is completely relaxed and the head dropped forward.

Returning to the front of the body, to discover what counteracts the combined pulls of all these upper-back and shoulder muscles, we find our answer in the two great chest muscles, the *pectorals*. The Greeks loved to define these almost as though they were twin square tiles or plates on either side of the sternum. In the well-developed athlete the surface form is indeed quite squarish, but the muscle underneath the skin is actually triangular. The square effect is caused by the unusual development of the lower border of the muscle, augmented by glands and fatty tissue lying just below and beyond the nipple.

The pectorals arise along the median line, from the inner portions of the clavicles, the edges of the sternal blade and the cartilages of the seventh ribs, thus forming the inner edges of the triangles. The fibers pass outward over the chest wall to the arms, those above slanting downward, and those below sweeping upward, forming the other two sides of the triangles. Beyond the chest wall these fibers converge and twist together as they overlap the muscles on the front of the arm and are inserted into the shaft of the humerus. Thus spanning the gap between the tapering thorax and the arm, the

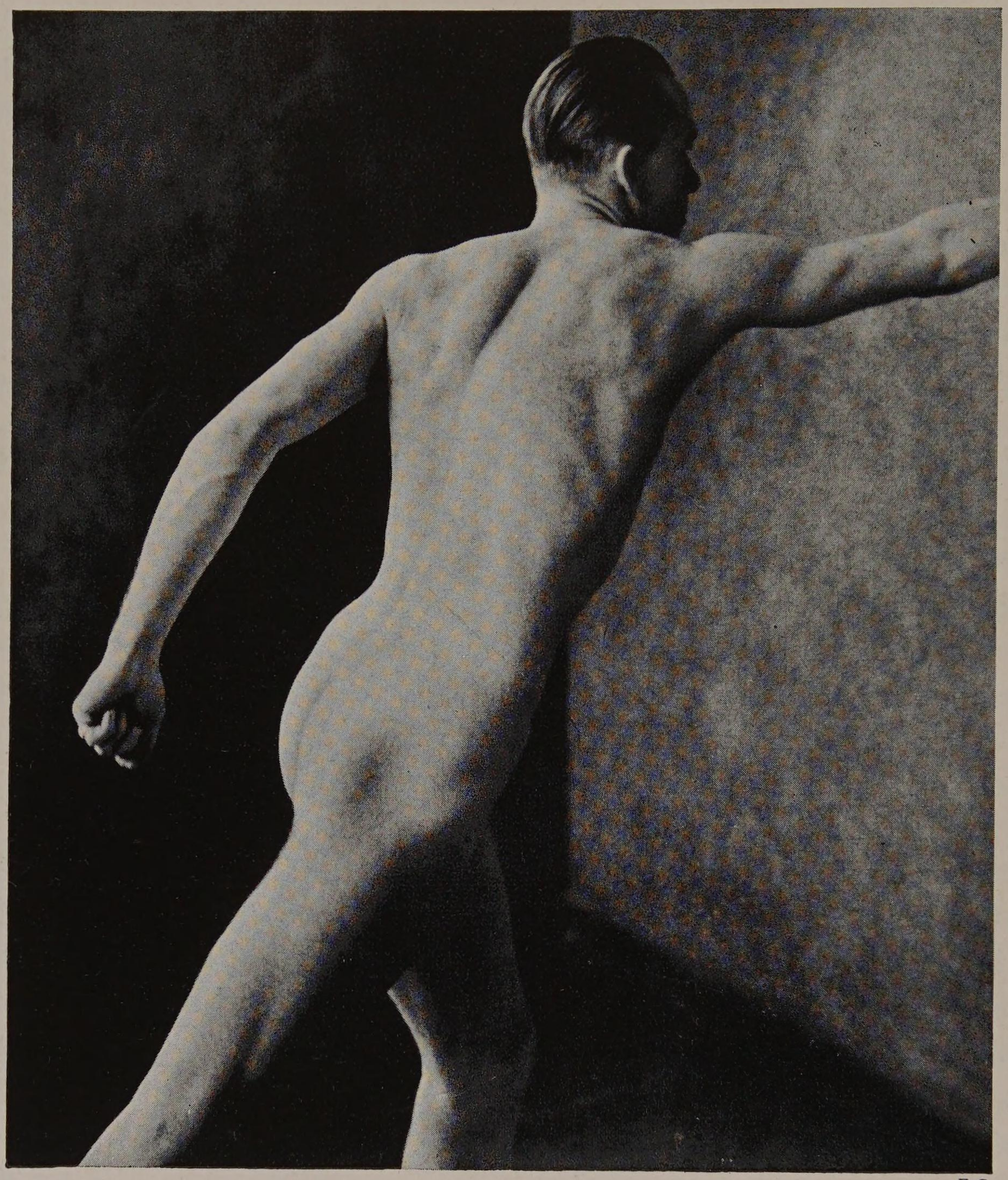
pectorals form the anterior borders of the deep armpits. When they contract they of course draw on the arms and pull them forward. Some anatomists divide each pectoral into a "major" and a "minor," the latter consisting of the small upper portion which arises from the center of the clavicle.

Before we consider the muscles of the arm, one fact must be clearly understood: muscles pass from one bone to another. If both ends of a muscle were attached to the same bone, no action could take place. (Except that the contraction of such a muscle would probably break the bone!) So, along the arm we find groups of muscles pulling on the bone below: those on the upper arm pulling on the forearm, those on the forearm pulling on wrist and hand, those of the hand acting on the fingers.

Serving as a link between body and arm muscles is an important one which "pads" the shoulder, completely covering the upper end of the humerus. Its name, *deltoid,* derives from the Greek letter Δ which, inverted, is similar in shape. The deltoid originates along the outer two thirds of the spine of the scapula, the acromion process and the outer third of the clavicle. The rear portion of it covers the outer ends of infra spinatus and teres minor. The fibers swell over the head of the humerus, then converge and are inserted one third of the way down on the outer side of the shaft of the humerus. Their anterior boundary meets the upper edge of the pectorals except for a small area just below the clavicle; this space may be noted in such Plates as 60 and 63.

The action of the deltoids is quite direct and simple. They raise the arms sideways by pulling from shoulder girdle to arm. Since they grow from the under side of the bony bridge, and the trapezius extends only to the upper edge, the skeletal structure here lies uncovered and directly under the skin. It can never be lost from view and shows either as a flattened prominence, when the arms are down, or as a depression sucked in between the swelling, contracted trapezius and deltoids when the arms are raised, as in Plate 63.

The familiar biceps would seem to be the next muscles to consider, but first we must look at two smaller ones which lie beneath them on the front of the humerus. From the coracoid process of the scapula to a point halfway down the shaft, is the *coraco-brachialis.* This small muscle may often be seen on the upper, inner part of the arm, helping to bridge the gap between pectorals and biceps. It assists other muscles in opposing the deltoids, and drawing the arm downward and forward. At the point where it is inserted, midway on the shaft, another muscle begins—the *brachialis anticus* (Diagram 45). This broader muscle which can be seen on either side of the narrower



E.S.

PLATE 63. Man, *Lunging Forward with Right Arm Up*

biceps, passes down over the front of the elbow joint and is inserted in the upper end of the ulna. By thus pulling on the forearm, it naturally acts as flexor of forearm on arm. Over both these brachialis muscles lie the *biceps,* probably the only muscles in the body whose names are familiar to everyone. As their name implies, these are "twin" muscles. That is, their fibrous parts are quite similar but, at either end, each has a tendon with individual character. You will remember the bicipital groove which distin-

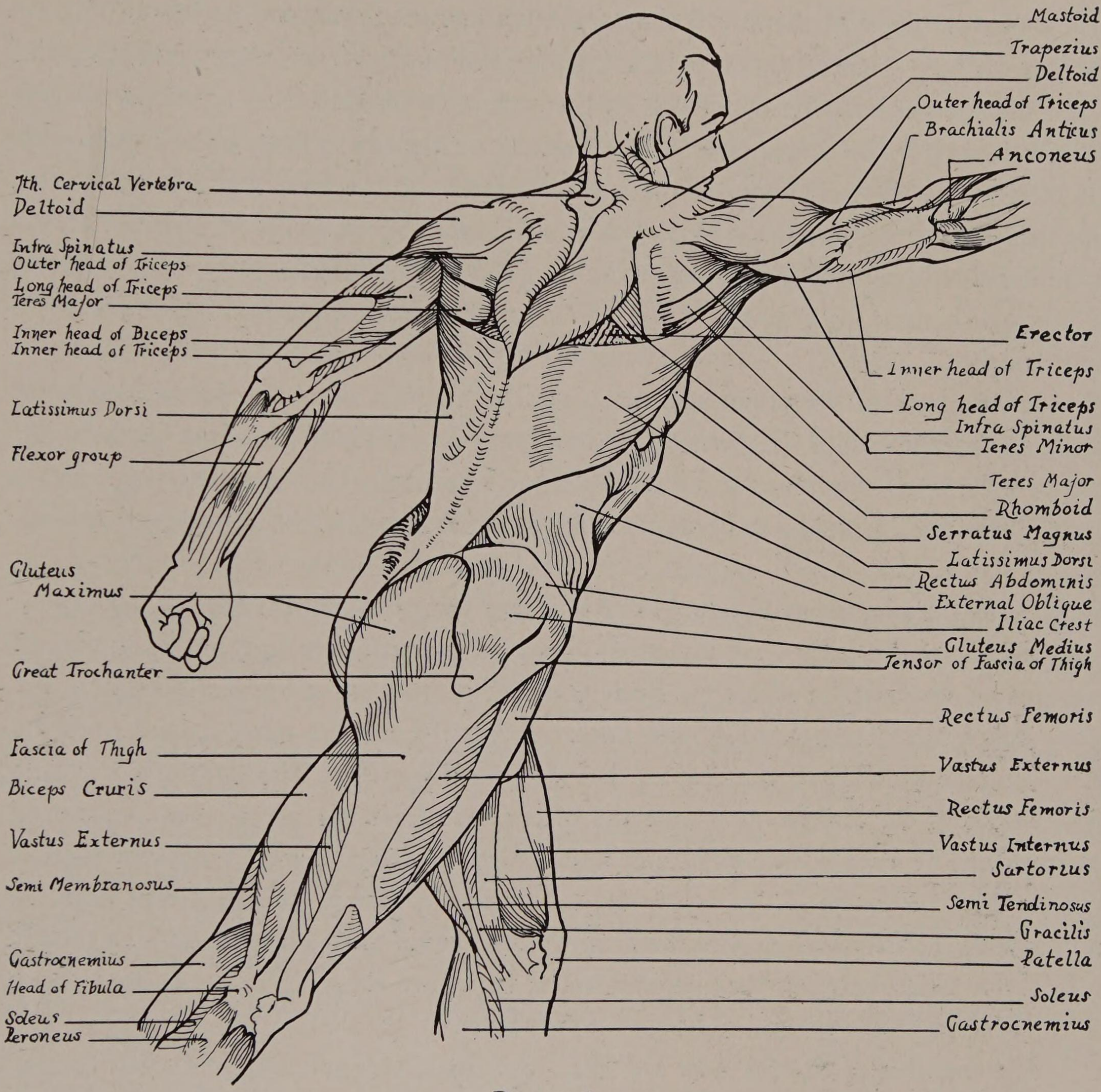


PLATE 63

guished the upper end of the humerus, separating the greater from the lesser tuberosity. Along it lies the tendon from the inner "head" of the biceps, which tendon is attached to the coracoid process. The tendon of the outer head is shorter and attaches to the scapula just above the arm socket. Almost all limb muscles taper to these ropelike white tendons instead of tying directly down to the bone as do the body muscles. The muscular bodies of the biceps thus begin only where they appear from under the deltoids. And

just above the front of the elbow they again become tendinous and each tendon goes its separate way. That of the outer head plunges to insertion in the upper end of radius while that of the inner head remains on the surface, spreading fan-shaped downward and inward over the upper ends of the muscles on the inner side of the forearm. If the biceps were attached above to the humerus, their sole function would be to flex the forearm, but as the upper tendons attach to the scapula, we know that they also act upon the shoulder girdle and assist in drawing the arm up and forward. Both ends are in vigorous action, for example, when a man lifts his own weight and "chins" himself on a trapeze.

On the back of the upper arm, separated both by the bone and by the brachialis anticus from the biceps, lie their opponents, the *triceps.* There are three heads to the triceps—the outer, the inner and the middle, or long head. This so-called long head is actually shorter in muscular fibers than the inner and outer, but it possesses a long, broad, flat tendon which spreads over the lower two thirds of the humerus and attaches to the olecranon (Plate 63). Along the two sides of this tendon, inner and outer heads of the triceps are attached, thus giving a triple pulling power to extend the arm by drawing the elbow up. Both of these heads attach to the rear portion of the great tuberosity at the head of the humerus, but the middle head crosses over the inner and is attached to the scapula just behind the socket. The deltoid covers the upper ends of the triceps, as it does the biceps, but there is a less obvious separation in form on the back of the arm than there is on the front. There is another smaller muscle which, though it lies below the elbow hinge, should be mentioned here for it acts with the triceps to extend the arm. This is *anconeous*—a tiny triangle of muscle filling the space between the olecranon and the outer condyle. It is attached above to the tendon of the triceps and below to the ulna.

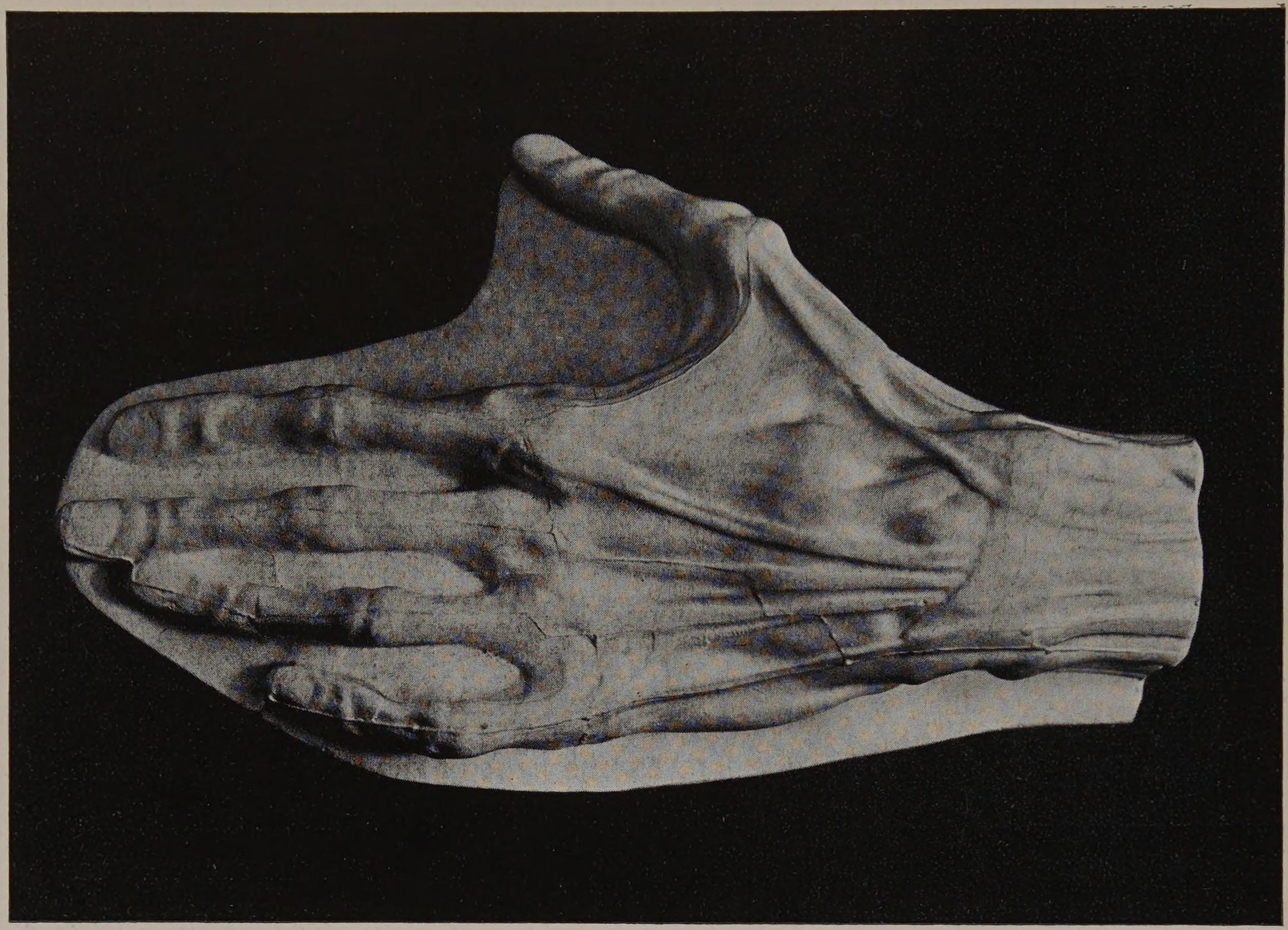
The muscles of the forearm are small but numerous and I have found that the best way to classify and remember them is to divide them into five groups: the *pronators,* the *supinators,* the *extensors,* the *flexors* and the *special extensors* of the thumb (Plate 61 and Diagram 45). We have already learned the meaning of the terms pronation and supination. Now let us try to discover what particular muscles cause pronation and supination.

From the sharp inner condyle of the humerus a small group of muscles passes diagonally across and below the front of the elbow, to a point about halfway down the radius. These are the pronators. By pulling on the radius they cause it to cross

over the ulna so that its lower end turns in toward the body. The lower ends of the pronators are covered by the two supinators. These arise on the outer side of the upper arm, well above the outer condyle, appearing between brachialis anticus and the outer head of the triceps. They twist forward and inward just above the condyle and pass down the radius to the wrist at the base of the thumb. When these twisted muscles straighten themselves (like the proverbial line between two points) they draw the radius out parallel with the ulna and the result is supination. They also assist in flexing the forearm on the arm.

Next to the supinators, on the outer side of the arm, and filling the long, narrow gap between radius and ulna, lie the *extensors* of hand and fingers. All of these attach above to the outer condyle. First comes the radial extensor, then the common extensor of the fingers, then a small special extensor of the little finger and lastly, lying along the ulna, the ulnar extensor. The upper ends of all these muscles attach directly to the condyle, but the lower parts of the muscles are thin, wiry tendons which fasten to various parts of wrist and hand. Those of the common extensor split at the wrist into four separate tendons which pass over the back of the hand and the knuckles, and are inserted into the phalanges of the fingers. Around the wrist is a flat "bracelet" called the *annular ligament,* which binds all the tendons from the arm muscles, so that when the hand is drawn sharply up and back, these tendons still cling close to the wrist, although the pull is from elbow to knuckles.

Opposing these various extensors on the outer arm are the flexors on the inner, smooth side. These flexors all arise from the inner condyle, passing down to wrist and palm, and filling the space between ulna and radius (Plate 63). Nature, herself, helps us to distinguish between the extensors and the flexors, for she leaves the outer edge of the ulna bare of muscles and close to the skin so that it acts as a partition between the two groups. Notice the arm of a plump, middle-aged woman and see how easily this groove made by the ulna can be traced. It is not difficult to identify the tendons of the flexors on your own arm if you tense them by flexing the wrist and clenching the fist. All but one of these pass under the annular ligament. The exception is the tendon of *palmar longus* which spreads over the palm of the hand. For sculptural purposes it is quite unnecessary to learn more about these flexors. What is of infinitely greater importance to sound construction is the fifth group which has not yet been mentioned.



E.S.

PLATE 64. Cast of Hand with Skin Removed

We know that the thumb pulls away from the hand and we realize that it must have special equipment of its own. From a point about halfway down the inner side of the shaft of the ulna, three small muscles arise, cross diagonally over the end of the radius and emerge between the tendons of the radial extensor and those of the common extensor. Here at the inner side of the wrist, one of the three is inserted, while the two others continue as tendons down to the phalanx of the thumb. On some people these tendons are very marked with a deep hollow between them at the base of the first metacarpal, or thumb bone. These thumb extensors not only strengthen the wrist but form a distinct second curve on the upper surface of the arm. Thus, on the side of the radius we have two curves—that of the supinators above and that of the thumb below, while on the ulna side we find a single curve extending from elbow to wrist.

There are no muscular bodies on the back of the hand, although there is a

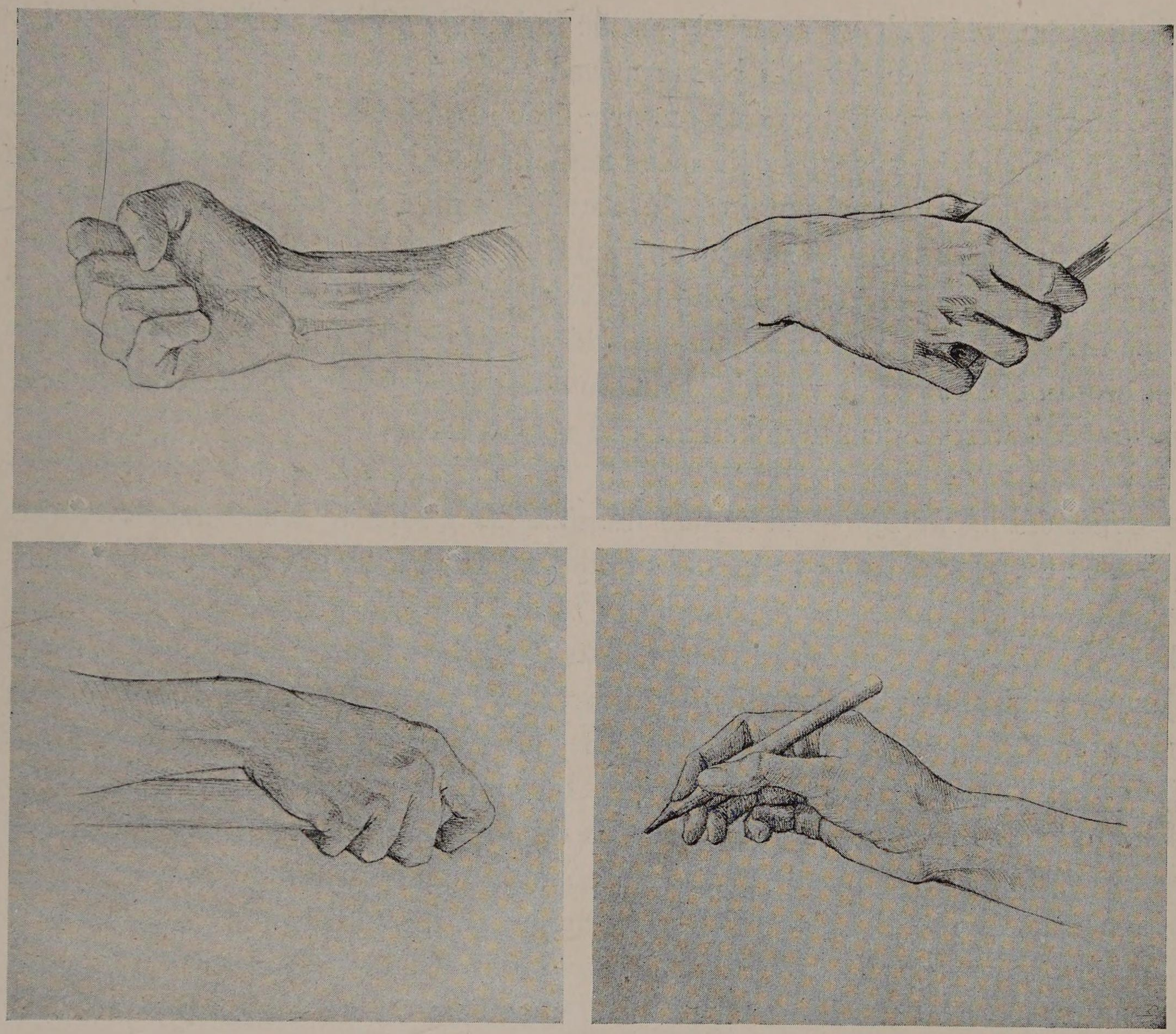


PLATE 65. Hand Studies. Brenda Putnam

webbing of small interosseous muscles between every two metacarpai bones. Consequently the bones and the tendons of the extensors are very near the skin and should be modelled in planes and slightly concave surfaces to show the hardness of bone and tendon. The delicate muscles which lie on and control the minor actions of the individual fingers are mainly flexors and we find several large flexors on the palm of the hand. Between first and second metacarpals, for instance, is a thick group known as the *adductors,* which draw the thumb to the hand. And the largest mass on the palm, at the root of the thumb, is used in opposing the thumb to the other fingers. At the base of the fingers is still another group and one more along the outer edge

of the palm, which draws especially on the little finger. Plate 64 shows a cast of a hand from which the skin has been removed.

Mere printed words, however, can give little idea of the real shape and structure of the hand, and the student should spend much time studying, drawing and modelling his own hands in different positions. Such studies as those in Plate 65 will give him a sounder understanding of hands than would long chapters of detailed description. Hands are difficult—every artist will admit that—but the more you study them, the more they "make sense" and delight one with their infinitely expressive gestures. Just one word of warning: never make them too small. Far better to go ahead boldly and make them oversize than to understate and neglect them.

Muscles of the hips—All around the shoulder girdle we found muscles which act upon the arm; so around the pelvic girdle we may expect to find those which act upon the thigh. The largest and strongest of these, indeed the strongest muscles in the body, are the two which form the buttocks. These lie on either side of the V-shaped sacrum, originating both from its two sides, and from the posterior quarter of the iliac crest (Plate 66 and Diagram 46). They are called the *gluteus maximus*. From the coccyx these muscles separate and pass outward, downward and forward to the upper ends of the thighbones. The gluteals have two thick layers of fiber, one lying on top of the other. The under layers plunge down to insertion in a ridge at the back of the femur, while the superficial layers remain on the surface, attaching, not to a bone, but to a wide, flat tendon which passes down the outer side of the thigh to the knee. The chief function of these muscles is to extend the thigh; that is, to draw it backward in line with the spine and to serve almost as much as the erectors in supporting the standing body. They are aided, moreover, by deep ligaments which bind from the sacrum and ischium across to the femur. You will observe in all plates and diagrams of the backs of standing figures, that there is a marked difference between the shape of these muscles in the diagrams and the shape in the photographs. In the diagrams the gluteus muscles sweep in an unbroken curve down and forward from the coccyx; while in the photographs, the lower border is *horizontal* and marked by a deep crease. This difference is due to a quantity of fat overlying the inner and lower borders of the gluteus. This fat folds into a crease when the thigh is fully extended. As soon as the thigh is relaxed, however, and the bone slants forward, as when the knee is bent, the true shape of the muscle becomes evident. Note the contrast

in the rear views of the figures in Plates 77 and 82, between the square shape of the gluteus of the supporting thigh and the long curve of the relaxed one.

The anterior border of the gluteus stops just before it reaches the great trochanter, so that that important projection of bone is well on the surface, uncovered by muscular fibers, and behind it is a wide, concave area, deepest when the gluteus is sharply contracted.

In front of the gluteus maximus, lying at the side of the hips, and passing almost straight down from the central portion of the iliac crest to the great trochanter *gluteus medius* is discovered (Plate 63). This muscle fills the concave space between the wing of the pelvis and the projecting trochanter. Its fibers converge and attach to the upper border of the trochanter. From its direction we deduce its function: it draws the thighs out sideways, away from each other, by pulling the trochanter upward.

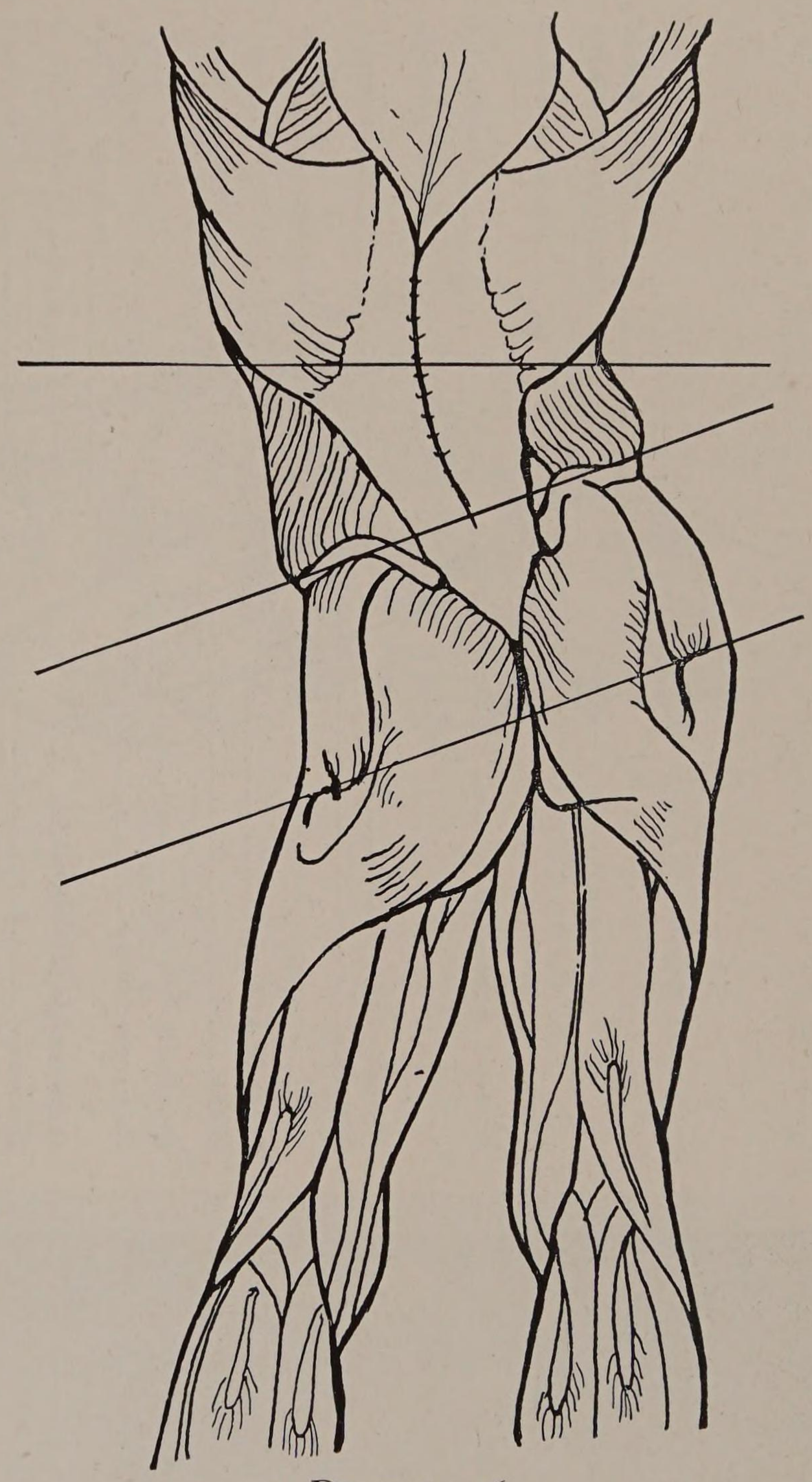
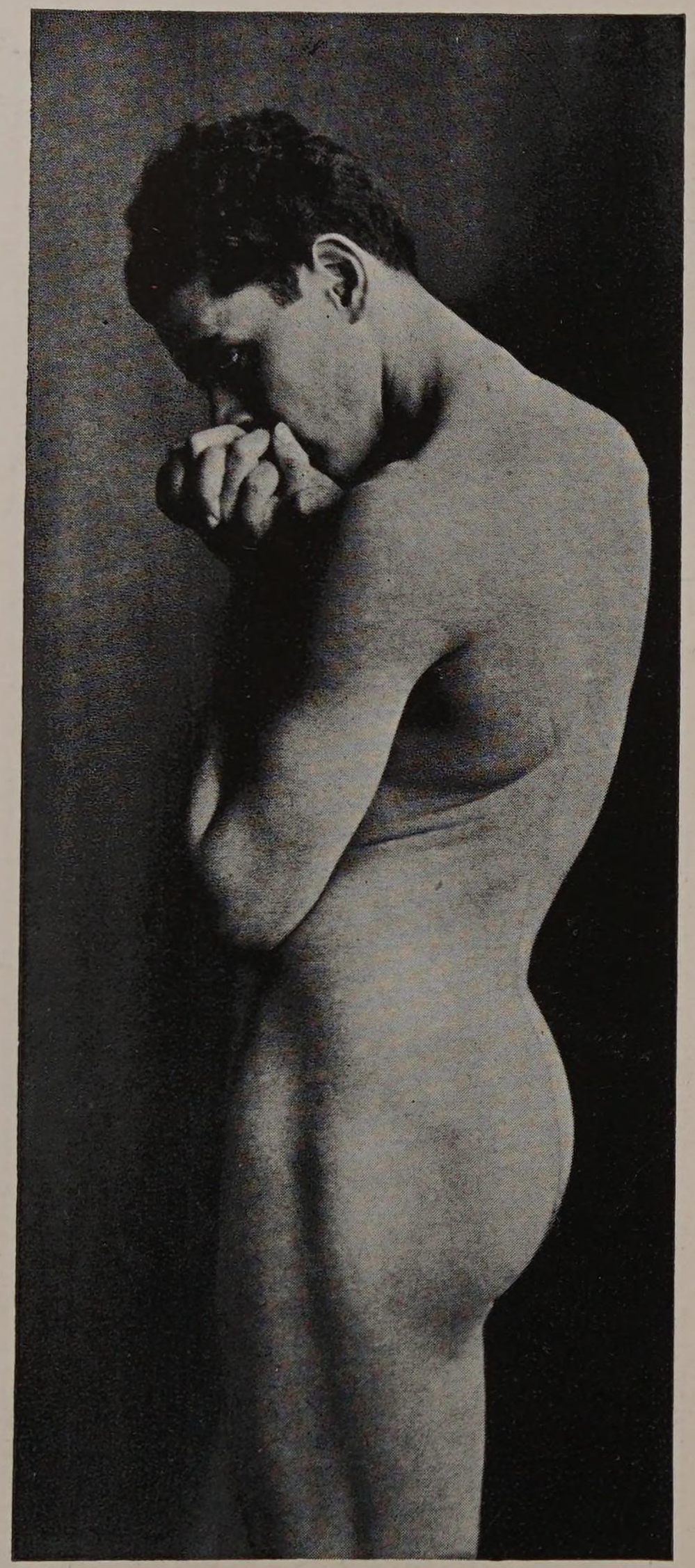


DIAGRAM 46

The third and last hip muscle has the longest name, but the smallest muscular body (Plate 67), the *tensor of the fascia of the thigh* arises from the anterior superior iliac spine. It is much narrower than either gluteus and not very long, but just in front of the trochanter toward which it slants, it becomes a sheath of tendon which, just below the trochanter, merges with that of gluteus maximus and passes down the outer side of the thigh to insertion in the head of the tibia below the knee joint. From



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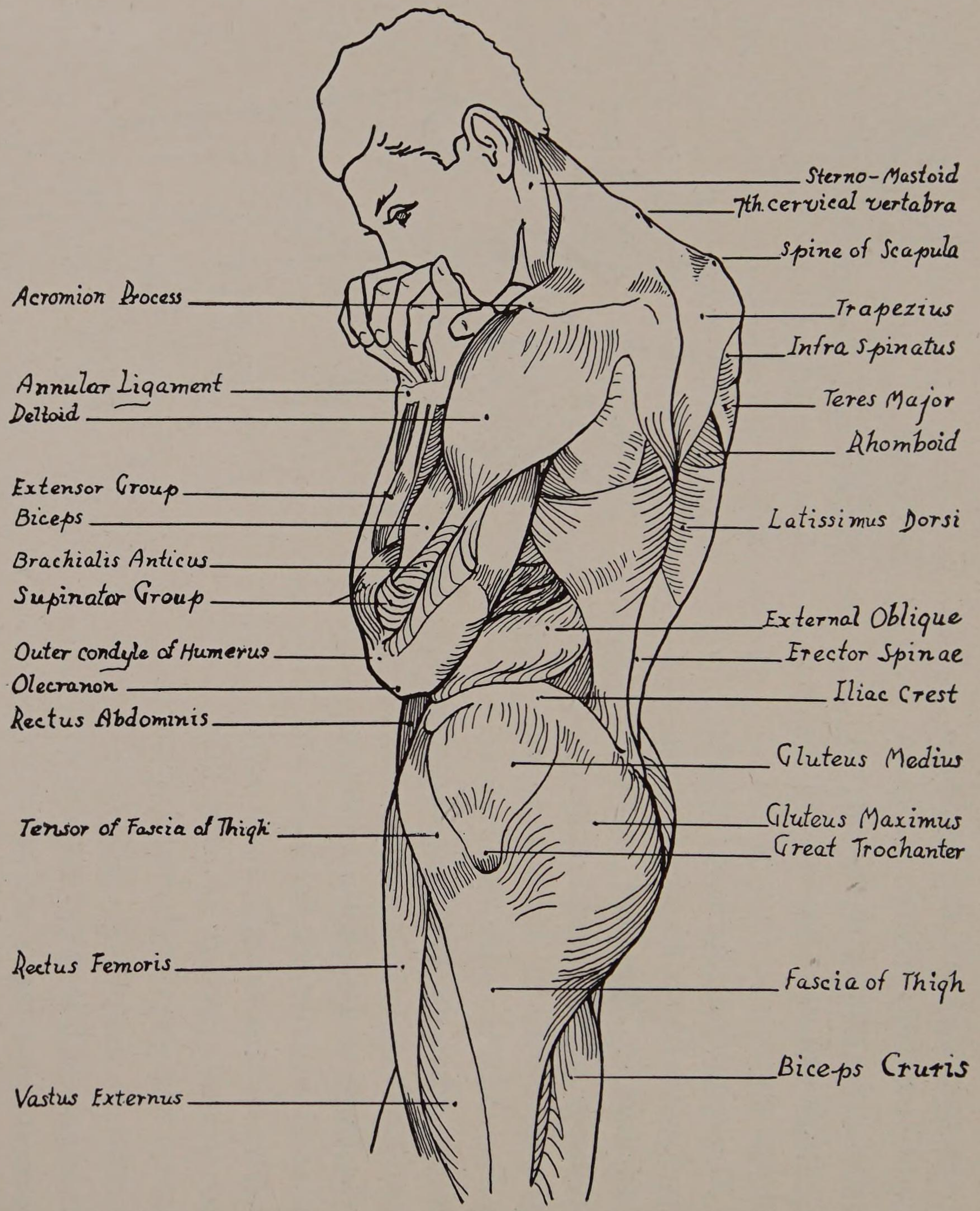
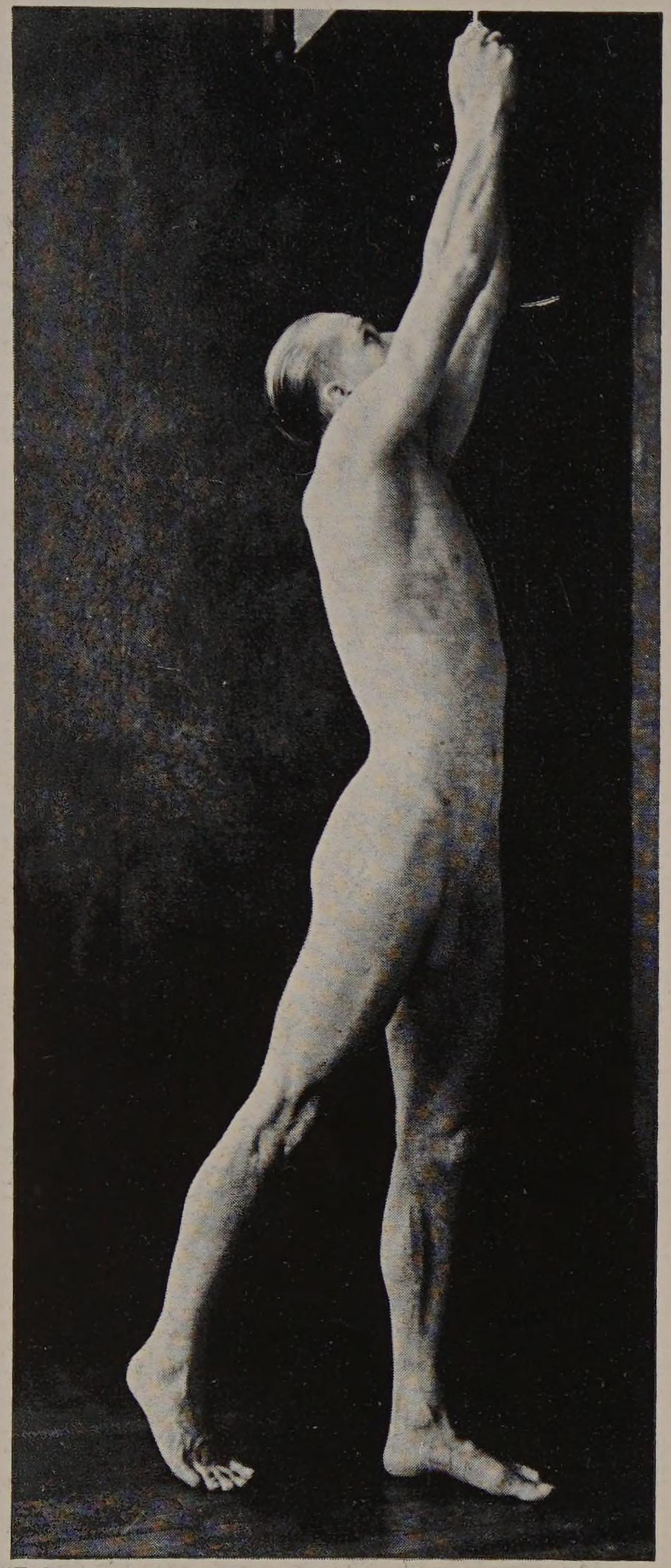


PLATE 66. Man, *Side View with Head Bowed*



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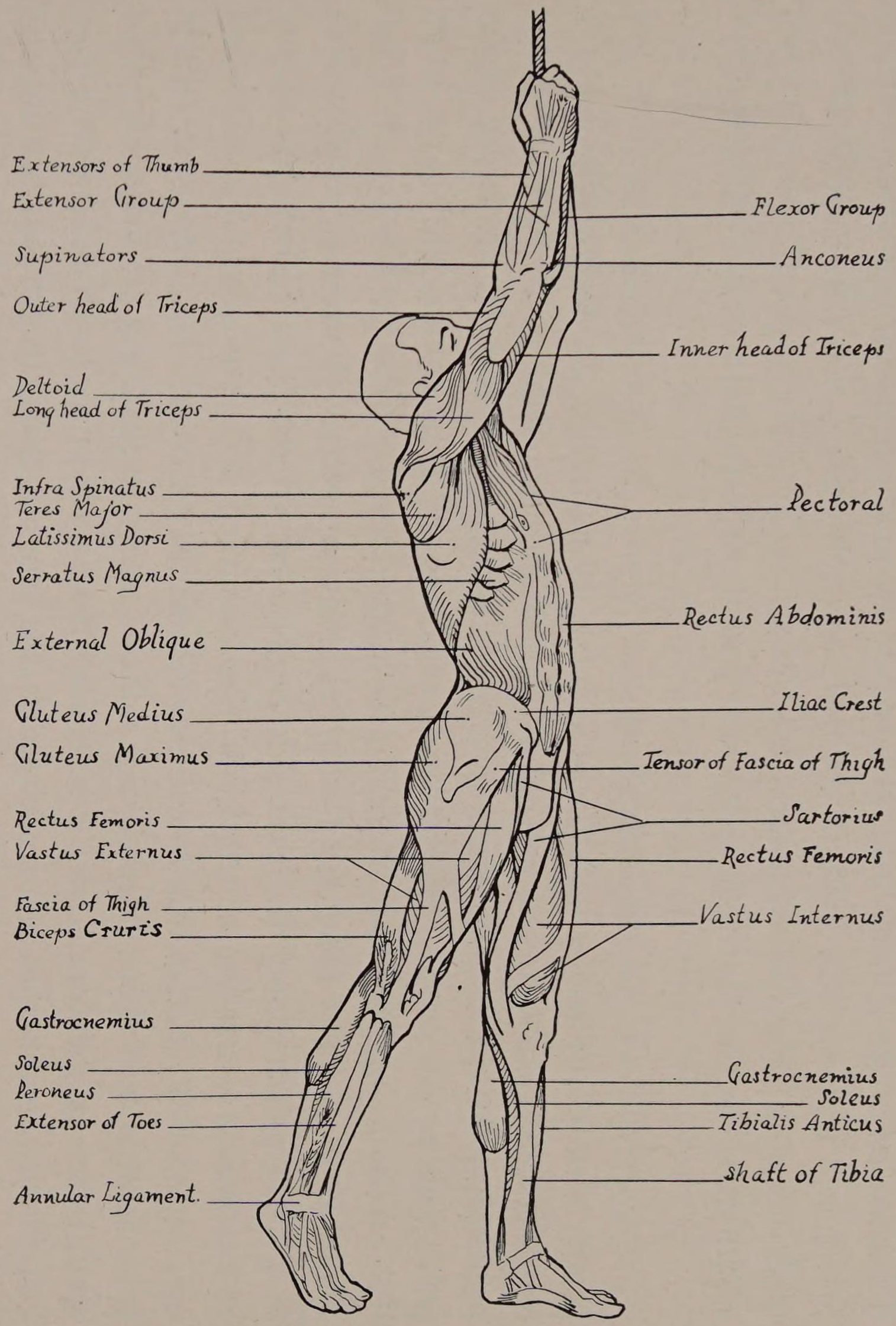


PLATE 67. Man, *Reaching Upward*

the direction of the muscle it is apparent that it acts in opposition to gluteus maximus, but, being comparatively small, it is aided in this thigh flexion on the trunk by several other muscles. Before we consider these, however, it might be wise to discover just where those muscles lie which counteract gluteus medius and draw the thighs together.

Muscles of the Thigh—Refreshing our memory by glancing back to front and back views of the entire skeleton (Diagrams 19 and 21), we observe that there is considerable space between the upper ends of the two femurs. Though they come together at the lower ends, their upper ends are separated both by the width of the pelvis and by the "necks" between head of femur and great trochanter. Yet we know that on the living body the thighs almost touch throughout their entire length. From symphysis pubis and from the two ischia, grow a number of muscles which attach at various points along the inner side of the shaft of the femur. These are known as the *adductor* muscles of the thigh. On the living body this group is so blended by a layer of fat, that, except in violent contortions, we cannot distinguish one muscle from another, so for our purpose it is sufficient to know that they are there. Only one requires special mention. This lies on the innermost side of the thigh and passes almost directly downward instead of outward to the femoral shaft. Its tendon, passing just behind the inner condyle, continues down to the inner side of the head of the tibia, so we know that *gracilis* acts not only as an adductor, but as a flexor of the leg on the thigh (Plate 58).

The outer ends of all the other adductors lie buried under four great muscles on the front of the thigh. Three of these parallel, in arrangement and action, the triceps muscles on the back of the arm. You will recall that while the inner and outer heads of these arose from the tuberosity of the humerus, the middle head crossed over from the edge of the scapula. On the front of the thigh we find the parallel. From the great trochanter grow two large muscles comparable to the inner and outer head of the triceps, while a muscle corresponding to the middle head arises from the pelvis. *Vastus externus,* as the outer head is called, passes almost directly downward to a point an inch or two above the knee where it becomes a tendon attached to the patella. It forms the great mass of the outer side of the thigh. Much of it is covered by the tendinous fascia of the thigh, but its posterior border extends backward beyond this tendon. *Vastus internus,* on the other hand, crosses over the femur to the inner side of the thigh, growing larger as it descends and becoming thickest just above

the inner condyle, while its short tendon attaches to the patella. This end of the internus extends considerably lower than the corresponding end of the externus, thus accentuating the inward sweep of the thigh from hip to knee (Plate 71). What corresponds to the middle head of the triceps is *rectus femoris,* arising not from the trochanter, but from the anterior inferior iliac spine and passing down the very front of the thigh. Its muscular body is not so long as either vastus, but halfway down becomes a strong tendon which, merging into those of the vasti, is inserted into the upper border of the patella. These tendons pull upon the patella just as the triceps tendon pulls upon the olecranon. On a man in a seated position, we observe at the knee the squarish forms of the two condyles, the flattened planes about the kneecap and the marked swelling of the vastus internus above the inner condyle. The ligament from patella to tibia is usually quite marked also. In fact the structure of the knee is far easier to analyze when the knee is partially flexed than it is when the knee is extended in a standing position. One reason for this is that between the patella and the condyles are several cushions of fat. When the knee is partly flexed, the muscles on the front of the thigh relax, the patella lies free, away from the end of the femur, and the fatty cushions are not pressed upon. But in the standing leg, particularly if the vasti and rectus are tensed, the patella is drawn tight against the femur and its cushions of fat squeeze out on either side, making bulges and puckers which complicate the external form.

Now we come to a fourth muscle on the thigh of which there is no counterpart on the arm. This is *sartorius,* the long, ribbonlike band extending from the anterior superior iliac spine to a point below the inner part of the knee. This is the longest muscle in the body, and what a beautiful S curve it has! Slanting inward from the iliac spine it lies close to the inner edges of rectus femoris and vastus internus in turn, marking the boundary between them and the adductor groups. Uniform in thickness (or in narrowness) throughout its length, it sweeps around behind the inner condyle, then curves forward again below the knee and is inserted in the shaft of the tibia just below its table top. The function of this muscle is obviously to compensate for the lack of pronation and supination of the lower leg. It rotates the thigh both inward and outward. Although the main action of leg and thigh is a backward and forward movement, as in walking, this limb has also considerable power of rotation at the pelvic socket. Gluteus maximus enters into outward rotation while the adductors and sartorius enter into inward rotation of the thigh. Observing

the front or rear view of the thigh, we note that the external outline of it is a single curve from great trochanter to just above the knee; while the inner outline forms two curves separated by the ribbon-like sartorius. Those who know Latin may wonder why this particular muscle is dedicated to tailors. Research among old prints shows us that in olden days a tailor was always depicted seated cross-legged on a bench. Take the position yourself, and feel how forcibly these muscles come into play at every rising or sitting.

The lower end of vastus internus frequently puzzles the student, because in a weight-bearing limb the full lower end of the vastus is often traversed by a horizontal groove. This is due to the *band of Richer,* a slip from the fascia of the thigh, which passes inward above the knee to insertion near the lower end of sartorius (Plate 67 and Diagram 48). When one is working from the living model one finds that this groove has a disconcerting way of appearing and disappearing, as the model unconsciously contracts or relaxes the band, so it is not to be thought of as ever-present.

As muscles corresponding with the triceps are found on the front of the thigh, it follows that something like the biceps will be found on the back of it. Plate 68 should be of assistance here. I have omitted the right hip muscles, so that the various origins under gluteus maximus may be seen. As on the front of the arm, so on the back of the thigh we find the flexors narrower than the extensors. There are two long, superficial masses extending from the ischium to below the knee, which we might justly suppose to be the two biceps. But early anatomists have decreed that only the outer group shall be called *biceps cruris;* while they call the inner *semimembranosus* and *semitendinosus!*

Biceps cruris are, indeed, twin muscles, but instead of lying side by side they lie one on top of the other; likewise, semitendinosus lies atop semimembranosus. These two flexor groups meet along the center of the back of the thigh, separating just above the condyles of the femur. The line indicating this meeting, though clearly defined in these diagrams, is, however, seldom seen in the living thigh, as a sheath of fat blends them into a single smooth form. We see much the same effect on the front of the upper arm, where the biceps appear as one form instead of two. At the back of the knee, as on the front of the elbow, the tendons of the two flexor muscles separate, forming a hollow space which, in life, is filled with a fatty pad.

The deep layer of biceps cruris is fairly short, arising midway on the femur, but its fibers grow lower, and are actually broader than those of the superficial layer which

here narrows to a strong tendon inserted in the head of the fibula. This tendon forms the outer "hamstring" at the back of the knee. The superficial biceps arises from the ischium as do semimembranosus and semitendinosus.

Semimembranosus, the deeper of the inner flexors, has a fairly thick and somewhat twisted muscular body which appears first on one side, then on the other of the straight semitendinosus which lies above it. The tendon of the former is inserted directly into the top of the tibia, while that of the latter continues down and forward below the tibial head, forming a third inner "hamstring" (Plate 68). It seems hardly necessary to add that all four of these muscles are used in flexing the leg on the thigh. The characteristic hamstrings are most in evidence when the leg is only partially flexed and the bent knee is bearing the weight of the body as, for instance, when climbing stairs (Diagram 48).

One last word before we pass to the muscles of the leg. The *depression* down the outer side of the thigh which is frequently marked on a weight-bearing limb, is the line of demarcation between the rear edge of vastus externus and the forward edge of biceps cruris. The *flat plane,* just in front of it, is caused by the tension of the fascia of the thigh. As seen in profile, the long curve of the thigh is the front curve, while a shorter curve is made by the flexors at the back (Plate 67).

As we examine the front of the knee (Plate 71 and Diagram 41), we see that it is a roughly cube-shaped area entirely devoid of muscular bodies. The great joint here lies exposed to the surface with only tendons and ligaments between bone and skin. All the extensors on the thigh stop before they reach the joint, and the muscles on the shin begin well below the tibial head. The exposed inner surface of the tibial shaft should always be indicated in the modelled figure as a long, hard plane. Just to the outer side of it, and fitting into the curve formed by the ridge on the front of the shin-bone, lies *tibialis anticus* which, in a way, corresponds to the long radial extensor of the arm. Recalling that there is no supination or pronation to be carried out in the leg as in the forearm, we shall not seek, nor find, any muscles for this action. Tibialis anticus arises just below the outer anterior part of the tibial head, swings somewhat inward along the bone and becomes tendinous halfway down. The tendon passes under the annular ligament and is inserted into the side of the first metatarsal bone on the inner side of the instep. Though technically known as a dorsi-flexor, tibialis is practically an "extensor" muscle; that is, it draws the foot upward and inward. As the foot is already built at right angles to the leg, this action may seem to be, and

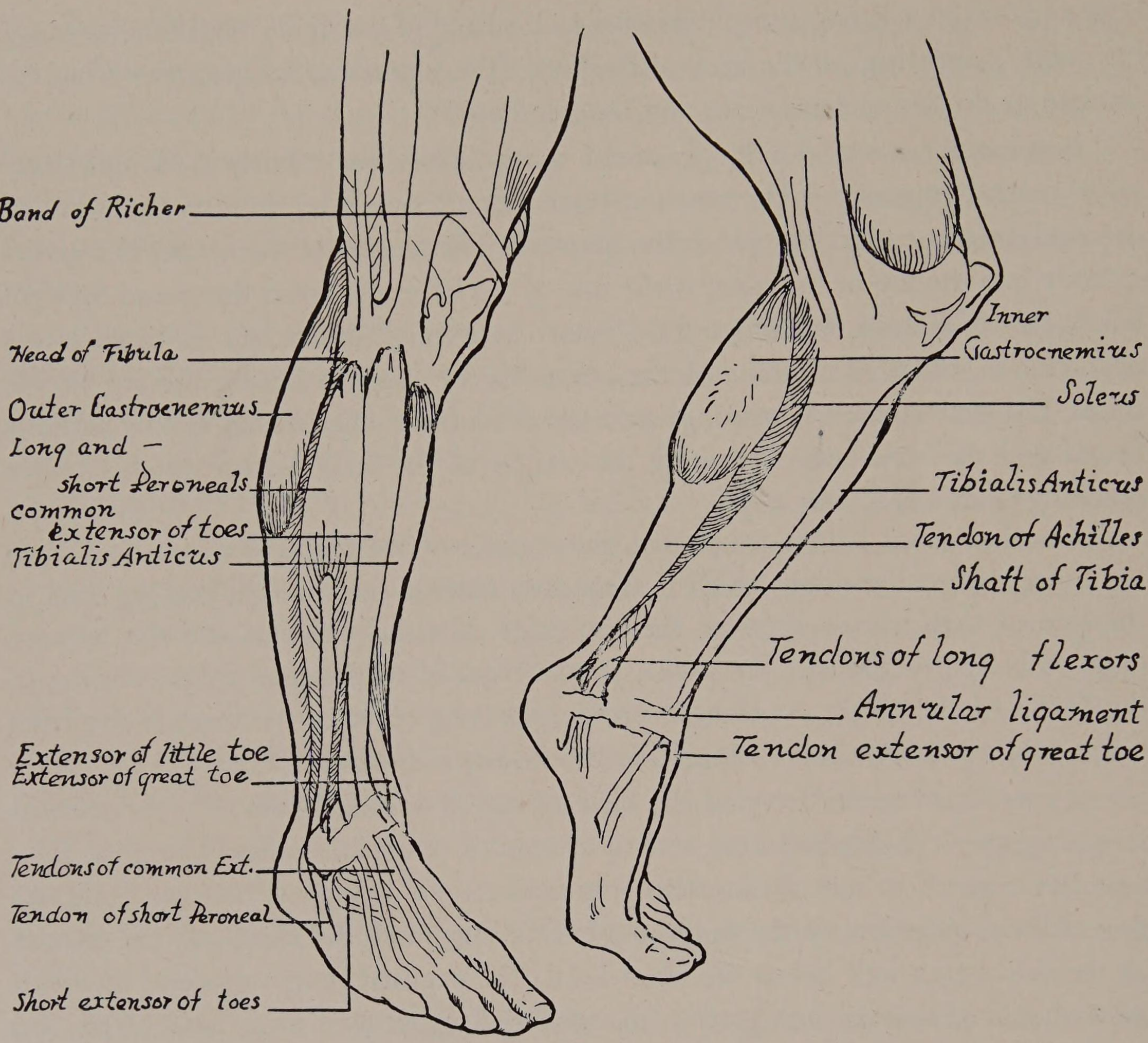


DIAGRAM 47

indeed is sometimes called, *flexion*. But you have only to try picking up a pebble with your toes instead of your fingers, to realize that your flexors are on the back of your leg and on the sole of your foot. Moreover, the companion muscles of tibialis, which are grouped on the outer side of the front of the leg, bear a striking resemblance to the various extensors of the forearm. Arising just beside tibialis is the smaller *common extensor of the toes* which, like tibialis, becomes tendinous halfway down. Its tendon divides under the annular ligament into four slips which pass along the foot to the four lesser toes. And, appearing between tibialis and this common extensor, where

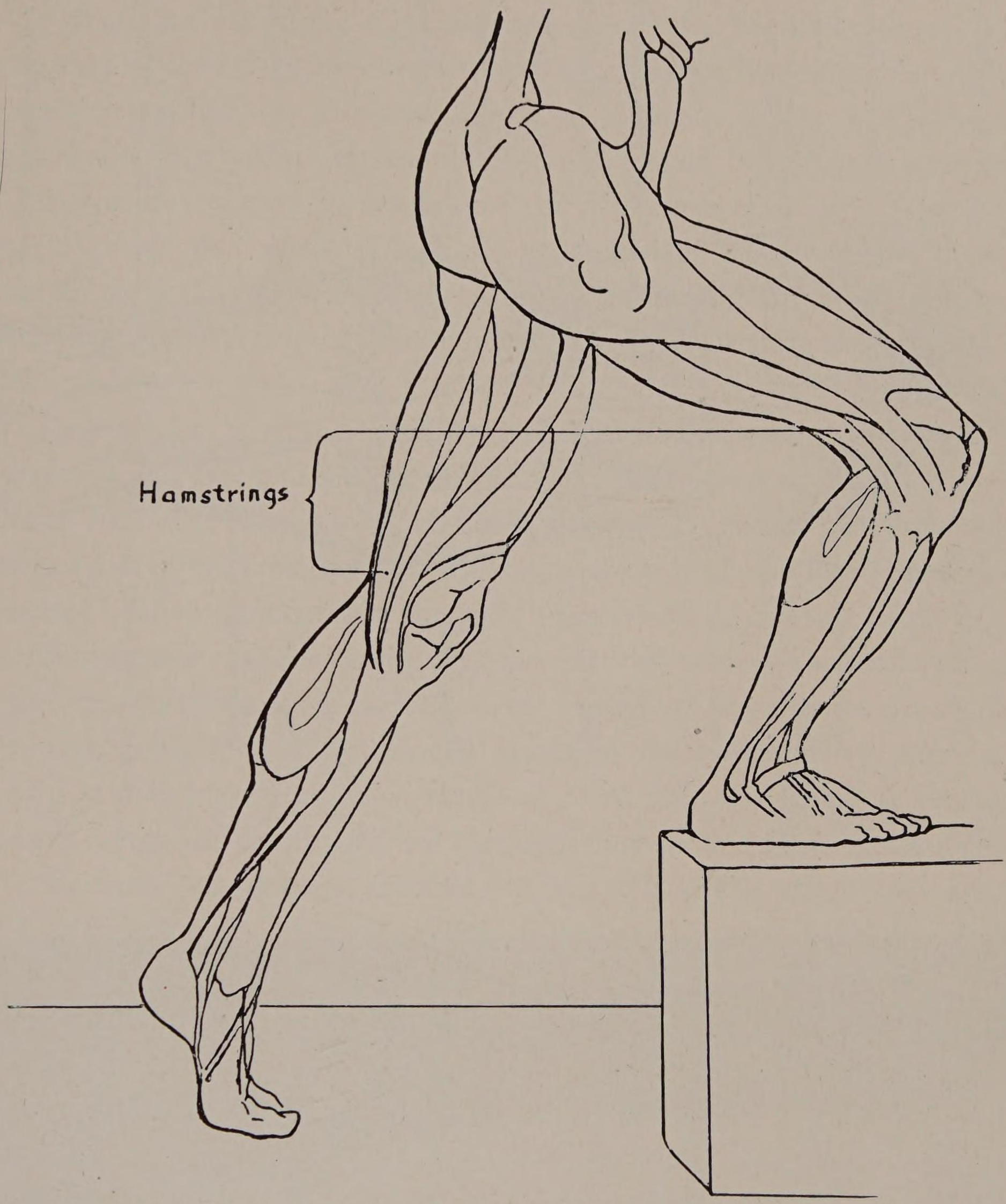
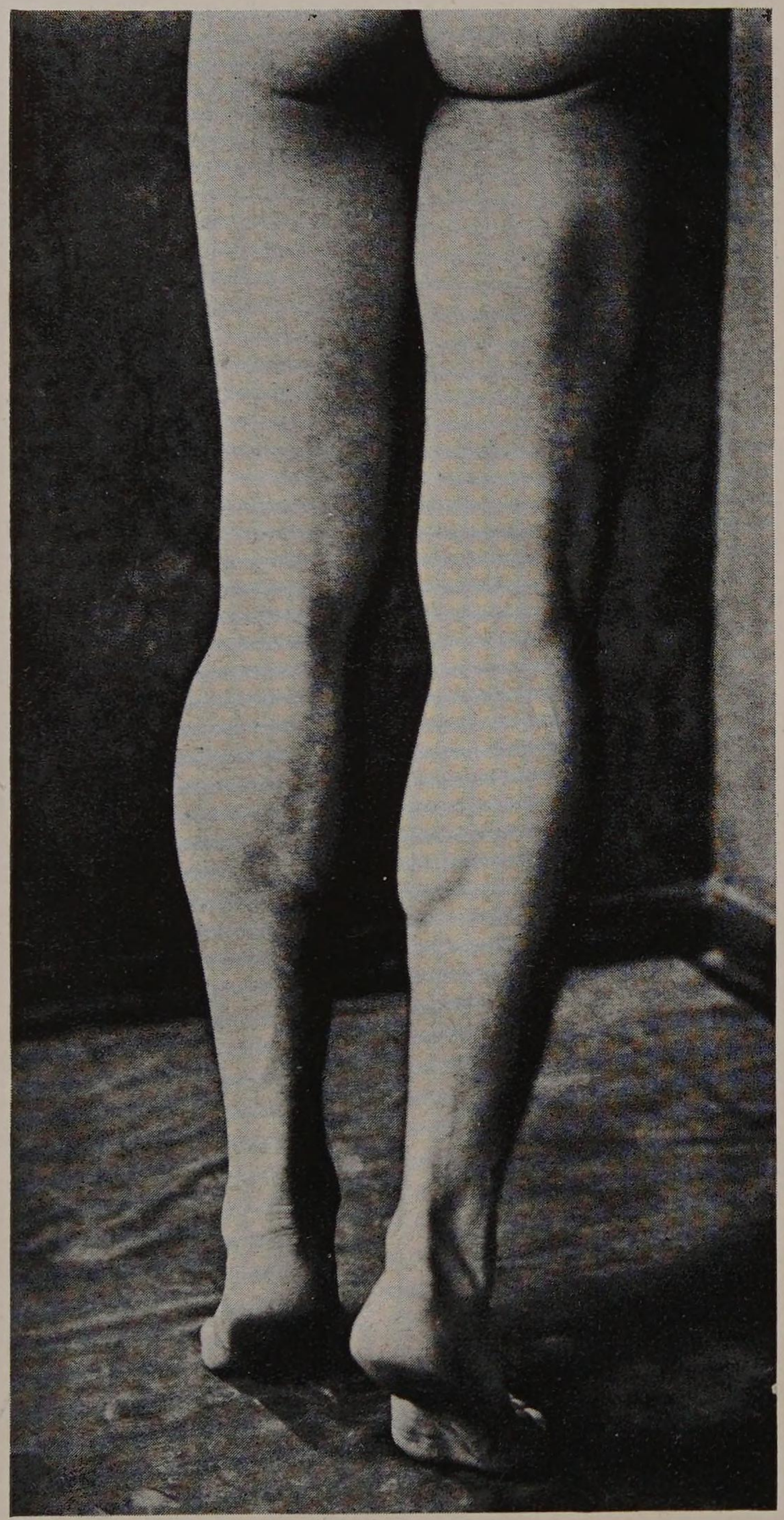


DIAGRAM 48

they become tendons, is the *special extensor of the great toe*. Only one is needed for the comparatively inactive great toe, where three were needed for the busy thumb!

Appearing much lower down on the leg, just in front of the outer anklebone, is a small *special extensor of the little toe*—hardly more than a slip of the common extensor. By this time we have moved around from tibia to fibula and the next two muscles arise from the head of the latter. These are the *long and short peroneals*. Like



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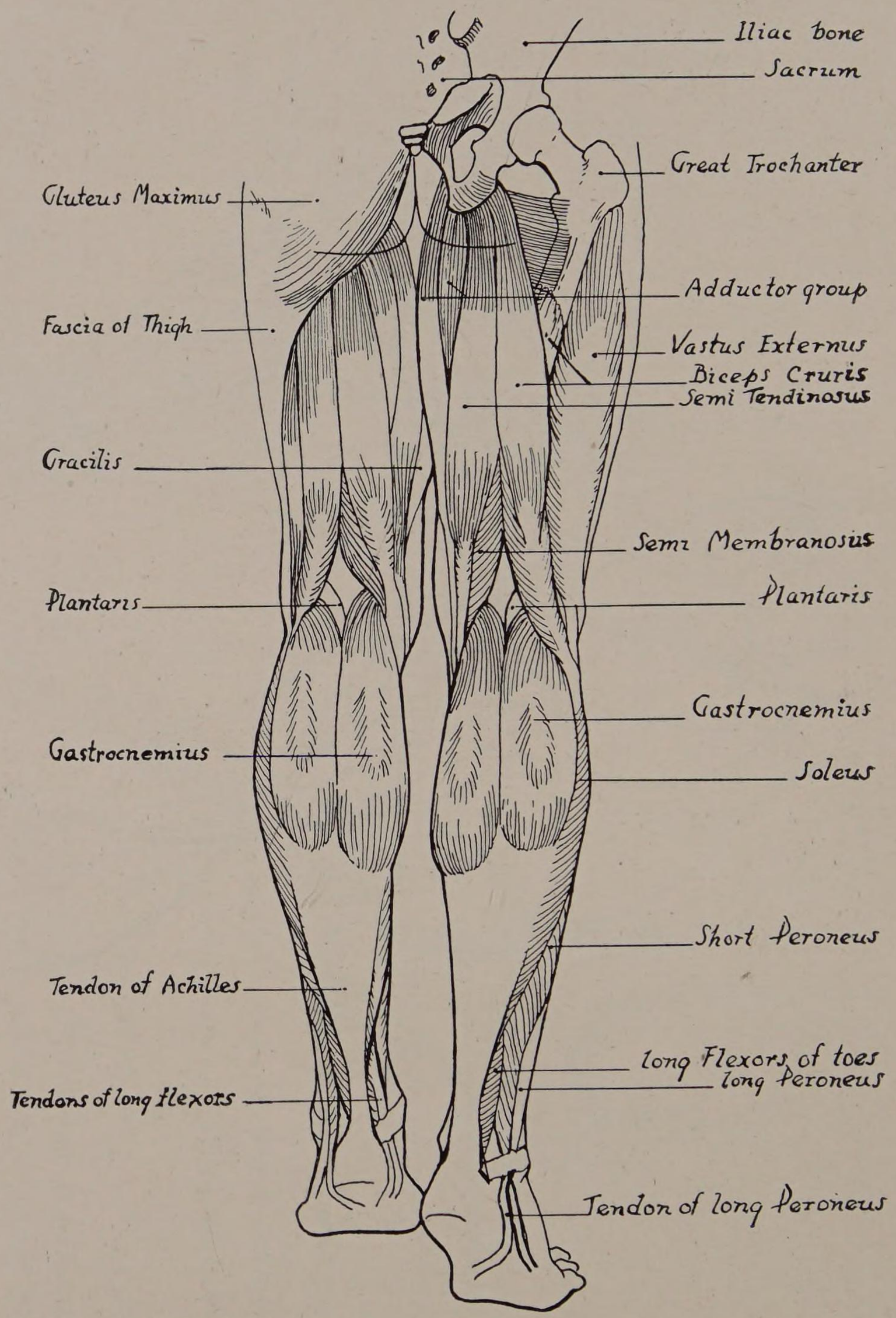


PLATE 68. Legs, *Rear View*

the biceps cruris on the thigh, these muscles lie one on top of the other. And, like them, the short peroneus extends lower on the leg as a muscle, while the long peroneus becomes tendinous halfway down the leg. Short peroneus retains its separate tendon, however, which, beginning just above the ankle, passes behind this bone and then shoots forward to insertion in the end of the fifth metatarsal bone. The tendon of the long peroneus also passes behind the lower end of the fibula, but then it does a curious thing: it twists inward, under the foot and across the instep and is inserted into the base of the first metatarsal. Of course it assists in arching the instep (Diagram 47 and Plate 68).

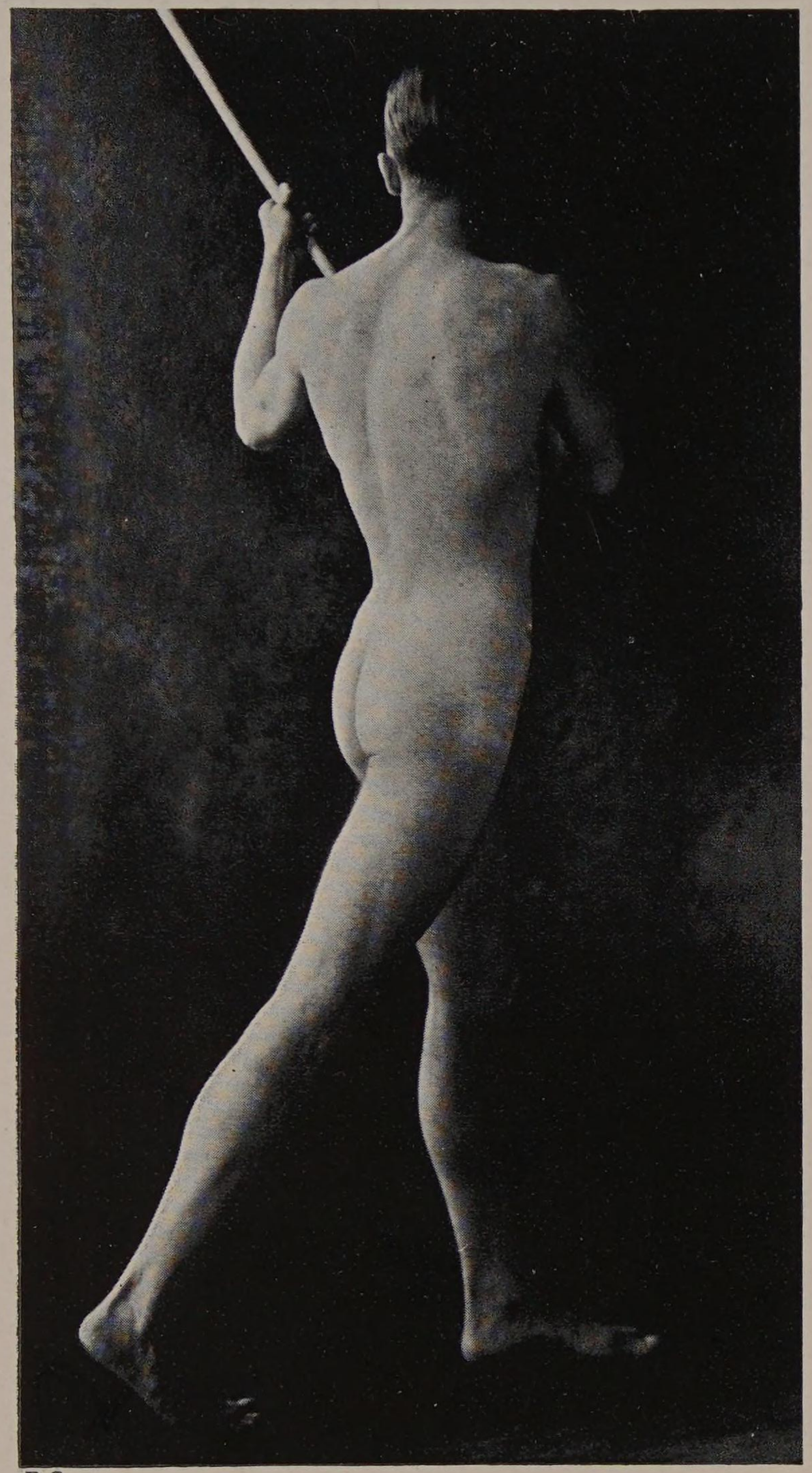
We have already observed that tibialis anticus raises the inner border of the foot. Try it yourself and feel and see the pull of the tendon across the front of your ankle. Now, raise the outer border and, at the same time, point the toes downward; you will feel the pull of both peroneals all the way up the side of your leg. The tendon of the long peroneal, when in action, makes quite a groove along the side of the leg. These are the last extensor muscles on the leg, but the foot possesses a small muscle on its upper surface, which the hand entirely lacks. Slightly in front of the outer ankle may often be seen a slight swelling. This is caused by the comparatively short muscular fibers of a muscle known as the *short extensor of the toes.* Its fibers slant forward and inward across the instep. All but the beginning of this short extensor lies under the tendons from the common extensor, so that it has little effect upon the surface of the foot except at its point of origin. A glance back to the skeleton of the foot (Diagram 37) will show you this point between the fifth metatarsal and the scaphoid bone; Diagram 47 and Plate 61 both show this muscle.

The deeper flexor muscles on the leg are quite unimportant sculpturally as they barely show on the surface but, logically, they must be noted. If we should strip away the great calf muscles from the back of the leg, we should see attached near the upper ends of tibia and fibula, and filling the space between the two, the *long flexors,* tendons of which pass downward behind the lower end of the tibia and the inner side of the calcaneum. One of these tendons runs straight down the under surface of the scaphoid and first metatarsal all the way to the last phalanx of the great toe. A second curves under the instep, separating into four tendons which pass to the four lesser toes. Owing to the overlying calf muscles and the great *tendon of Achilles,* we see on the surface hardly more than the lower third of these flexors, showing briefly on either side of this tendon, but their own two *tendons* make themselves felt

at the rear of the inner anklebone. These *long flexors* not only point the toes downward, but help us to grip the ground with our toes at every step (Diagram 47).

Starting from the back of the head of the fibula, and overlying the long flexors, is a broad muscle called the *soleus*. The outer border of this muscle lies just behind the peroneals and projects at the calf, forming its widest part. Less than halfway down the back of the leg the central portion of soleus merges with the strong tapering tendon of which we have already spoken—the tendon of Achilles. It continues as muscle for several inches on either side of the tendon which it shares with the two large calf muscles lying over its upper portion. These, the *gastrocnemii,* start from the upper rear surface of either condyle. They are almost twins, lying side by side on the calf, but the inner is slightly longer and more powerful than the outer. The central part of each gastrocnemius is flattened and tendinous. Note in Plate 68 that the upper extremities of these muscles are covered by the lower ends of biceps cruris on the outer side, and by semimembranosis and semitendinosis on the inner. The two gastrocnemii emerge from under these at a point well above the knee joint, thus causing the "break" at the back of the knee to lie distinctly higher than the front of the knee. (In profile this adds still another of those diagonal directions previously mentioned.) In the diagrams a diamond-shaped space can be discerned at the back of the knee, but living models show no such space, because, in the standing leg, there is a cushion of fat pressed out by the weight of the condyles which completely fills the hollow space. The inner gastrocnemius gives the inner calf its outline, and it can be seen clearly from the front because there are no muscles on the inner side of the tibial shaft. Below it we find the lesser mass of the inner edge of soleus and these two make the forward-curving ridge of muscle on the inner side of the leg. See the left leg of the man in Plate 67, and Diagram 47. The outer gastrocnemius is reinforced by a small slip of muscle called *plantaris* (Plate 68).

Both calf muscles plunge quite abruptly into the upper end of the tendon of Achilles and their lower edges are always clearly marked when they are contracted, as in Plate 68. Just above and behind the ankles, the Achilles' tendon pulls free from underlying bones and muscles and passes out to its insertion in the top of the outermost projection of the calcaneum. If we could tear away the skin of the living model behind the ankles we would be able to see right through between the tendon and the ankle. On the female this bold structure is often obliterated by layers of fat, and centuries of walking on high heels have tended to weaken and shorten both the calcaneum and



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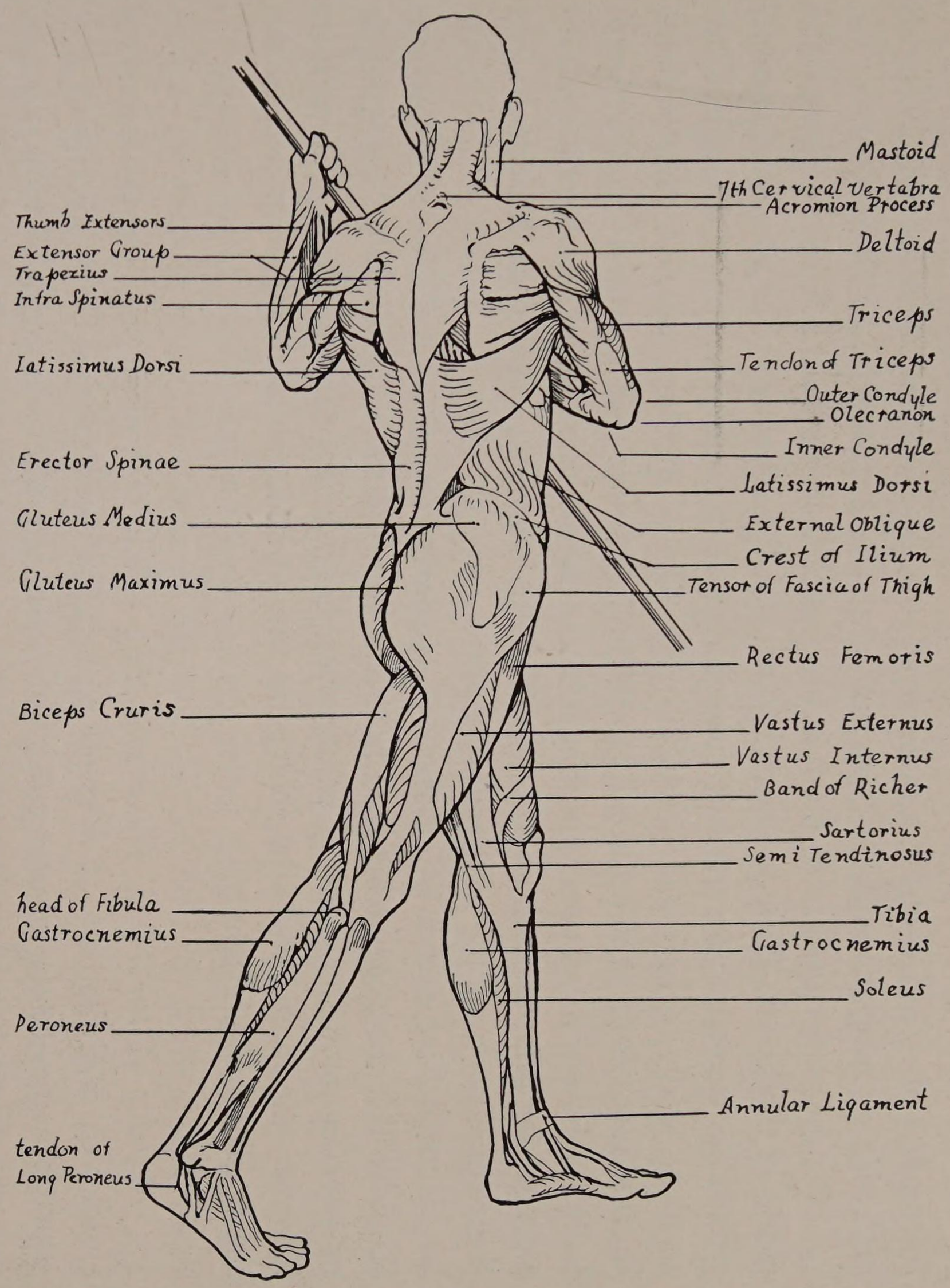


PLATE 69. Man, *with Pole*

the tendon of Achilles; but in a male figure, this part must be modelled with boldness and with a strong sense of the wiry pull of this most powerful of all tendons.

On the under surface of the foot are muscles similar to the flexor groups on the palms of the hands. There are even abductors and adductors of the great toe, reminiscent of our tree-climbing ancestors, but these have become so atrophied through disuse as to be fairly negligible. In modelling the sole of the foot, we find that its shape is based more on its skeletal structure than on its muscles (see imprint of foot, Diagram 37B), although in strained positions the central short common flexor stands out in a ridge. Between muscles and outer skin there is a dense cushion of thickened inner skin which obscures the individual muscles.

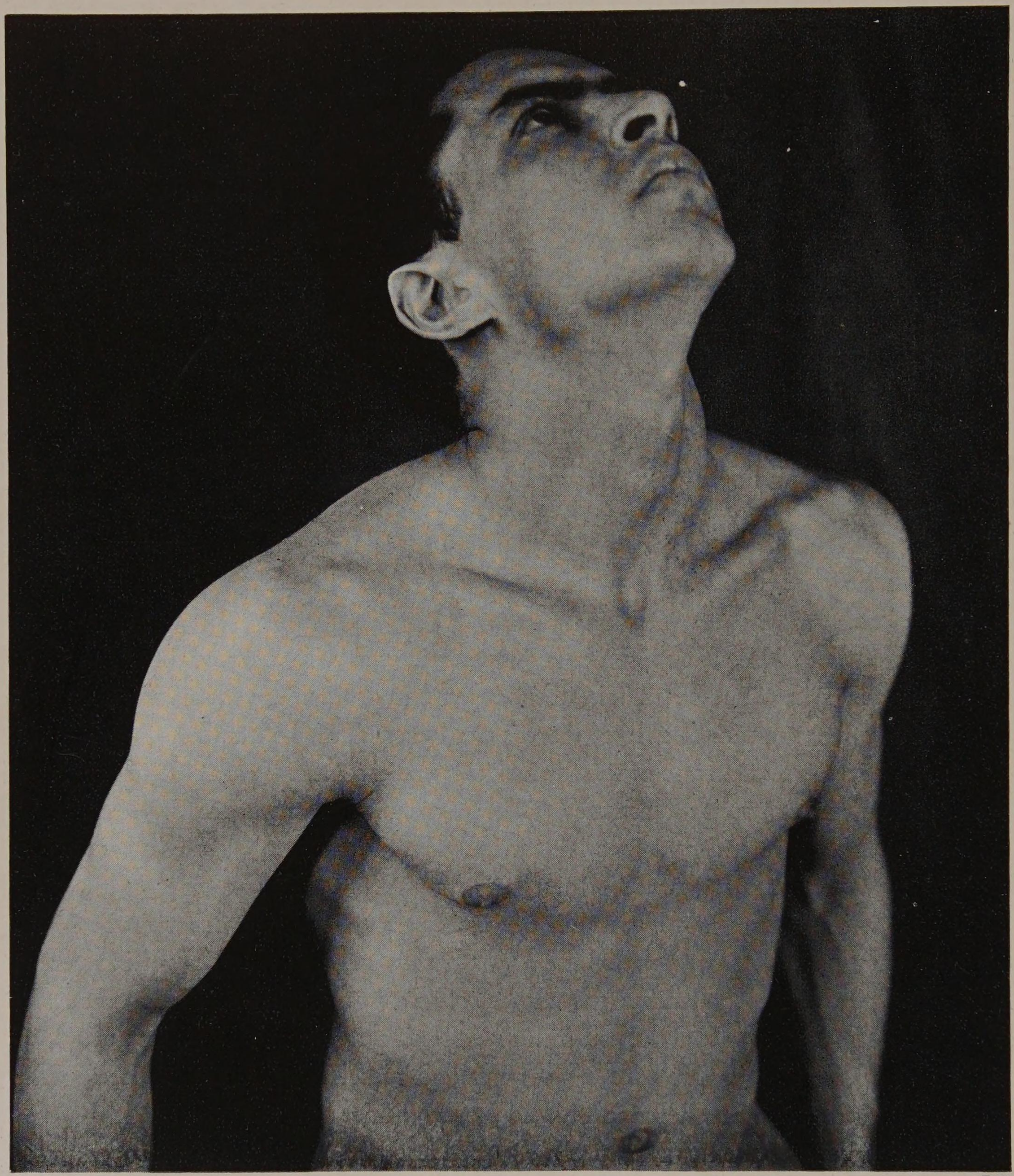
In modelling feet it is important to remember that along the inner edge nothing should touch the ground between heel and ball. Lift the instep well off the ground, or your figure will appear to be suffering from broken arches. On the outer side, however, the more firmly the foot grips the ground, the more vigorous will be the stance of the whole figure.

Muscles of the Neck, Head and Face—You will recall that the great erector muscles covered the back of the neck underneath the trapezius. Some anatomists give separate names to the several groups of these, but from our point of view it seems unnecessary to thus complicate them in our own minds. We know that they fill out the neck, both at the back and on the two sides (attaching either to the base of the skull or to the various cervical vertebrae) and by their actions lend great flexibility and expression to the movements of the head on the neck. They are, however, largely covered both by the trapezius and by two large, superficial muscles called *sterno cleido mastoids*. These lie on either side of the neck between the top of the sternum and the two mastoid processes behind the ears. They extend from the mastoid bones to the pit of the neck where they almost meet. Each muscle forms a fairly uniform broad band along the side of the neck, which as it nears the front, divides into two sections. The inner, and more tendinous of these, attaches to the hilt of the sternum while the outer attaches to the clavicle, just outside of the rounded inner head. These mastoid muscles, as we shall call them for brevity's sake, are unfortunately the only muscles of the neck of which the veriest tyro is aware. The beginner invariably lays these in, very prominent and stringy, without first building up the column of the neck underneath, and then he wonders why his neck looks so old! It looks old because

the spaces on either side of it have been left empty and concave. On a young, healthy man or woman the space between the upper border of trapezius and the rear border of mastoid is rounded out by the *splenius,* of the erector group, whose fibers pass diagonally forward and upward to the lower surface of the mastoid bones. Especially if the head be held erect and the chin drawn well in, they can be seen to arch as truly as does the neck of a fine horse. Never forget them, if you wish to make a strong young neck, nor neglect either the fullness of the throat. Undue hollowness here will have the same result, particularly if the chin be lifted and the head tipped back. For when this is done, the forward-curving vertebrae press upon the various tubes in the throat and cause them to curve forward also, filling the V and even rounding out beyond it (Plate 70 and Diagrams 40 and 49). There are small muscles in the front of the neck growing up from the sternum to the little hyoid bone and helping to open the mouth, but the sculptor needs to know less of them than of the cartilage of the larynx which, in most men, is quite markedly developed. In woman the thyroid gland, situated just below the larynx, is larger than in man while the Adam's apple is smaller. Consequently the front of her throat is much rounder and quite smooth.

Sometimes in violent action a small muscle is seen to cut across the side of the neck just above the clavicle and behind the lower end of the mastoid muscle. This *omo hyoid* grows from the inner side of the coracoid process of the scapula ("omoplatte" in French), to the hyoid bone of the throat. It lies quiescent except in case of strenuous effort as when a man runs a close race. Then it stands out like whipcord. What is also apparent in such strained positions is a curious sheath of fibrous tissue, known as the *platysma,* which extends from the lower cheeks and jaw over the sides of the neck and the clavicles where it merges with pectorals and deltoids. Photographs of Marathon runners at their last gasp exhibit this stringy substance, and you have but to stand before a mirror and draw the corners of your own mouth sharply down and back to see the same effect on yourself. Needless to say, one seldom has to depict this in sculpture but its presence gives an added reason for modelling the muscles of the neck as though blended and blurred by this "inner skin."

Over the top of the head, nature has placed another "inner skin," or aponeurosis, like a close-fitting cap. At the back this aponeurosis terminates in two small, muscular bodies which attach near the base of the occipital bone. In front it terminates on the forehead in two more frontal muscles which, when they are sharply contracted, not



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PLATE 70. Torso, *Head Thrown Back*

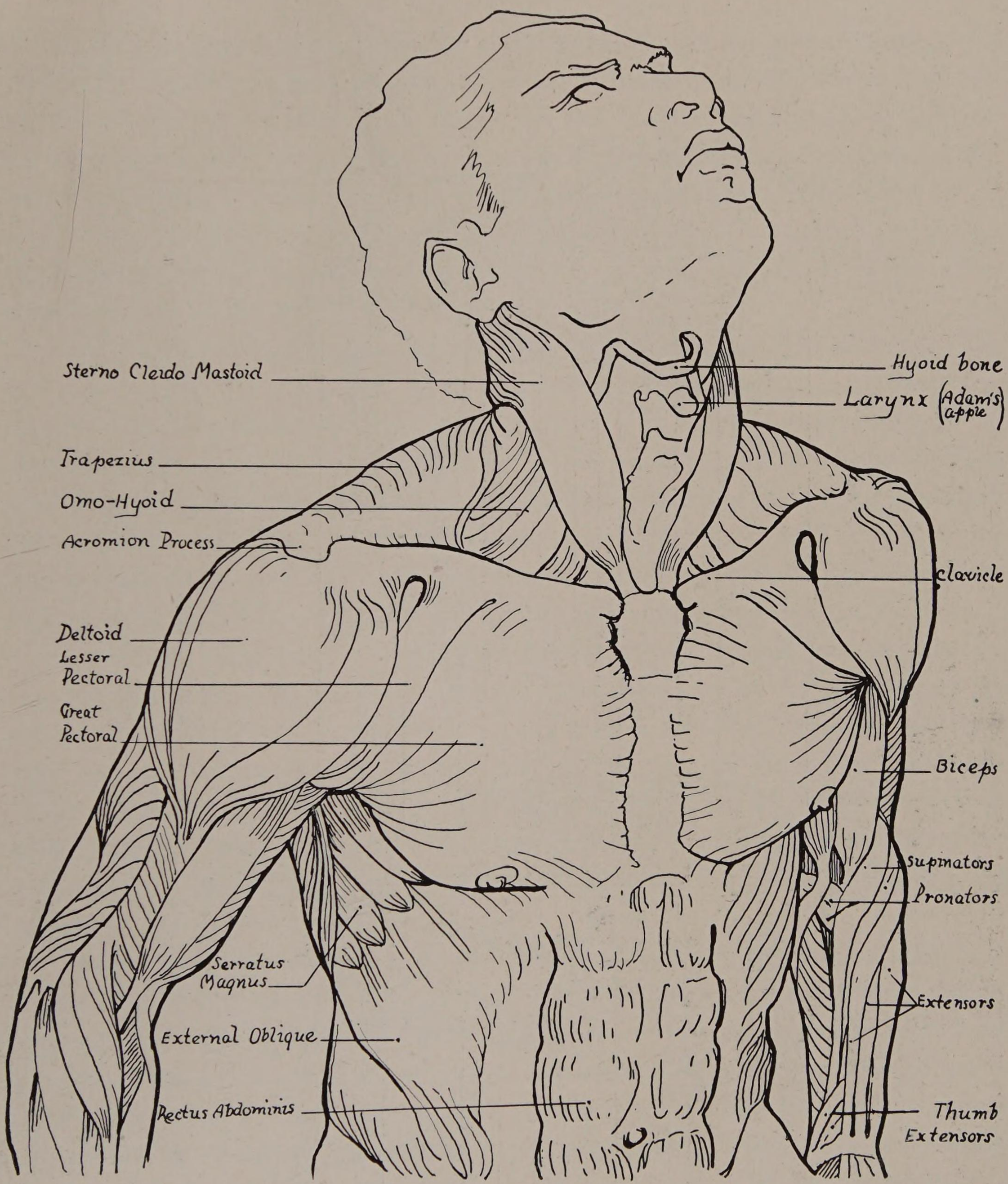

Sterno Cleido Mastoid
Trapezius
Omo-Hyoid
Acromion Process
Deltoid
Lesser Pectoral
Great Pectoral
Serratus Magnus
External Oblique
Rectus Abdominis
Hyoid bone
Larynx (Adam's apple)
clavicle
Biceps
supinators
Pronators
Extensors
Thumb Extensors

PLATE 70

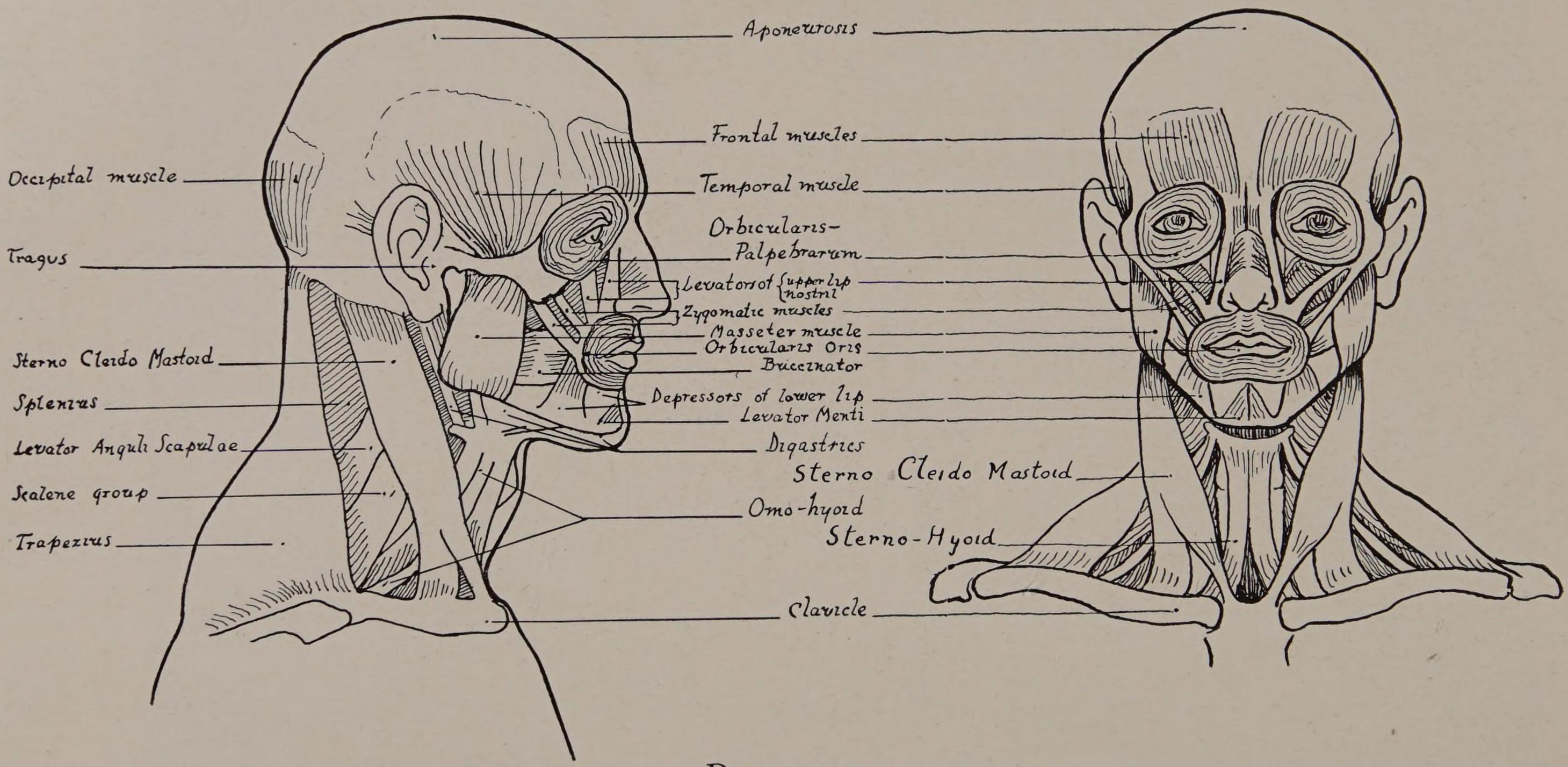

Aponeurosis
Occipital muscle
Frontal muscles
Temporal muscle
Tragus
Orbicularis-
Palpebrarum
Levators of {upper lip / nostril
Zygomatic muscles
Masseter muscle
Sterno Cleido Mastoid
Orbicularis Oris
Buccinator
Splenius
Depressors of lower lip
Levator Menti
Levator Anguli Scapulae
Digastrics
Scalene group
Sterno Cleido Mastoid
Omo-hyoid
Trapezius
Sterno-Hyoid
Clavicle

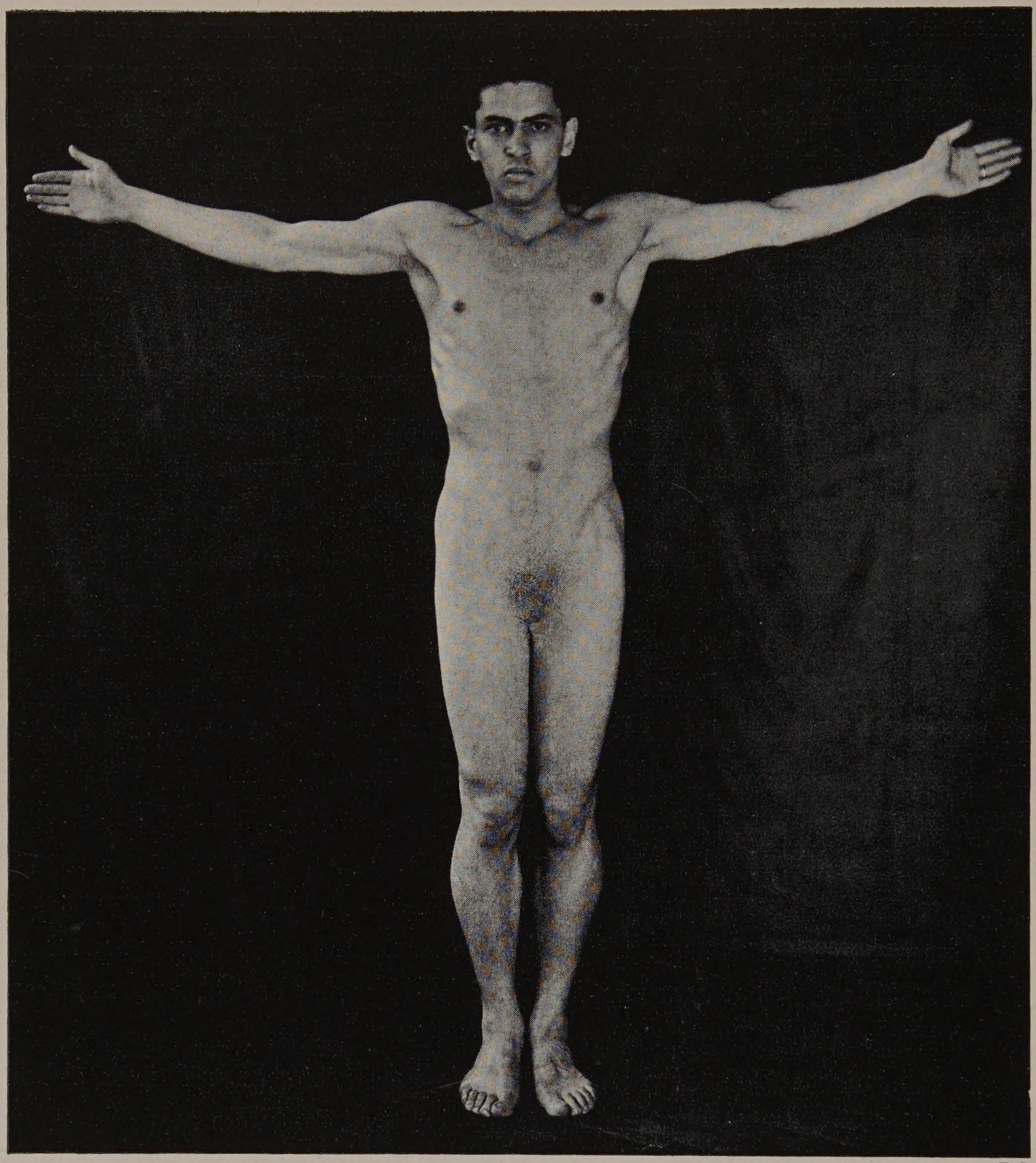
DIAGRAM 49

only raise the eyebrows but draw the aponeurosis slightly forward over the skull. About the ears man has only vestiges of what on most quadrupeds are active and important muscles. He who can "wiggle" his ears is quite a rarity among humans! So we find that only at the temples does the cranial box possess full-grown hard-working muscles. The fibers of these temporal muscles converge as they pass forward and downward under the bridge of the zygomatic arch. Here just behind and underneath the spreading malar bones they attach to the coronoid process of the lower maxillary and, by contracting, close the jaw.

The muscles of the face are quite delicate and very complicated. Moreover, though one can describe the position of each, it is not so easy to state its exact shape and degree of development, for here we are confronted by a new element—that of the character and personality of the individual. Here mind, to a large extent, triumphs over matter and lends more variety to the human face than can ever be described. But every sculptor seems to have in his own mind a kind of "type" face, just as the Greeks had theirs, and that will undoubtedly serve him until he graduates from figures alone to the more difficult and subtle problems offered by portrait busts.

Above the inner corners of the eyebrows, under the frontal muscles, are two muscles which point diagonally downward toward the top of the nose. These are the *corrugator,* or frowning, muscles. On the nose itself are several small ones. Around both eyes we find muscles the like of which we have not yet discovered. The fibers run in a complete circle all around the eyes in a flattened ring which spreads upward over the frontal part of the eye socket and downward over the upper parts of the malar bones. These fibers separate in the middle and also thicken, forming the upper and lower lids (Diagram 49).

From the inner corners of these *orbicularis palpebrarum* muscles, on either side of the nasal bridge, down to a somewhat similar "ring" muscle around the mouth, run two thin strips which draw up the upper lip and nostrils, as in sneering. From the malar bones, twin strips of muscle pass inward and down the cheek to the upper-outer corners of the round mouth muscle. These *zygomatic* muscles draw the corners up and out, as in smiling. On an emaciated person they are frequently very marked on the sunken cheeks. The *orbicularis oris,* as the muscle of the mouth is called, is formed much like one of the eye muscles but acts quite differently. For example, the eyelids can be squeezed tightly together, but one can neither purse nor grin with the eyelids. Being a sphincter muscle, the *oris* is more elastic than the palpebrarum. The



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PLATE 71. Man, *Front View, Arms Extended*

lip section has a very thin outer skin which causes the redder coloring of the lips. In the standard mouth the upper lip has three distinct forms—two fairly long with the third wedged between and projecting somewhat. The lower lip has two sections which fit into the curves between the upper three. As orbicularis oris lies directly over the horseshoe curves of upper and lower teeth, it follows that it too curves and the outer corners retreat backward from the center toward the cheek. On the inside

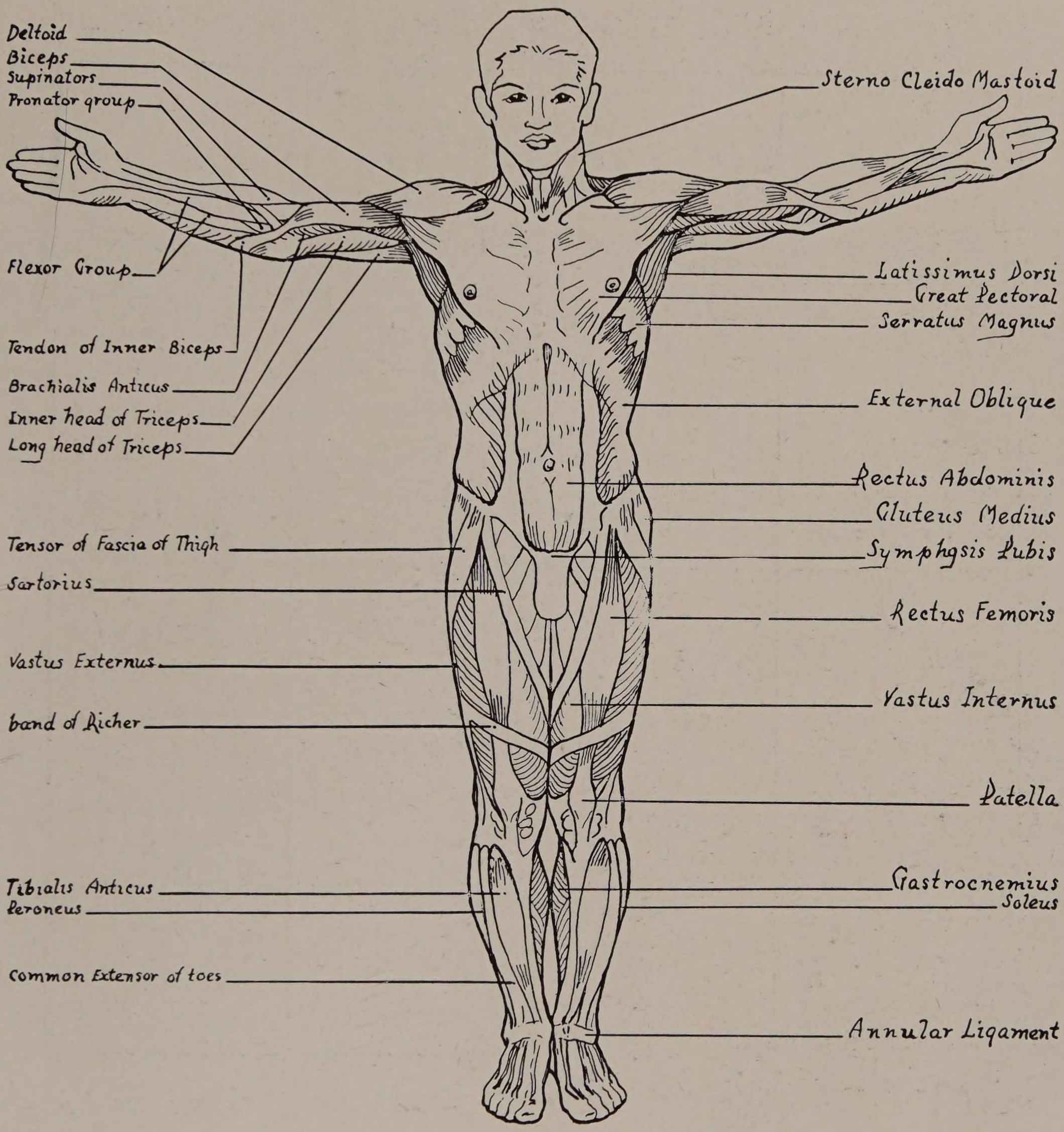


PLATE 71

of the cheek, running directly forward from the rear angle of the jaw to the outer corners of the mouth are the *buccinators* which draw the mouth out sideways. These help to fill in the hollow cheeks. They are partially covered by the two strips of zygomatic muscles and by the largest and strongest muscles of the face—the *masseters*. Rising from the lower edge of the prominent malar bones, these powerful "chewing" muscles pass down over the flat surface of the upturned rear angle of the jaw, and

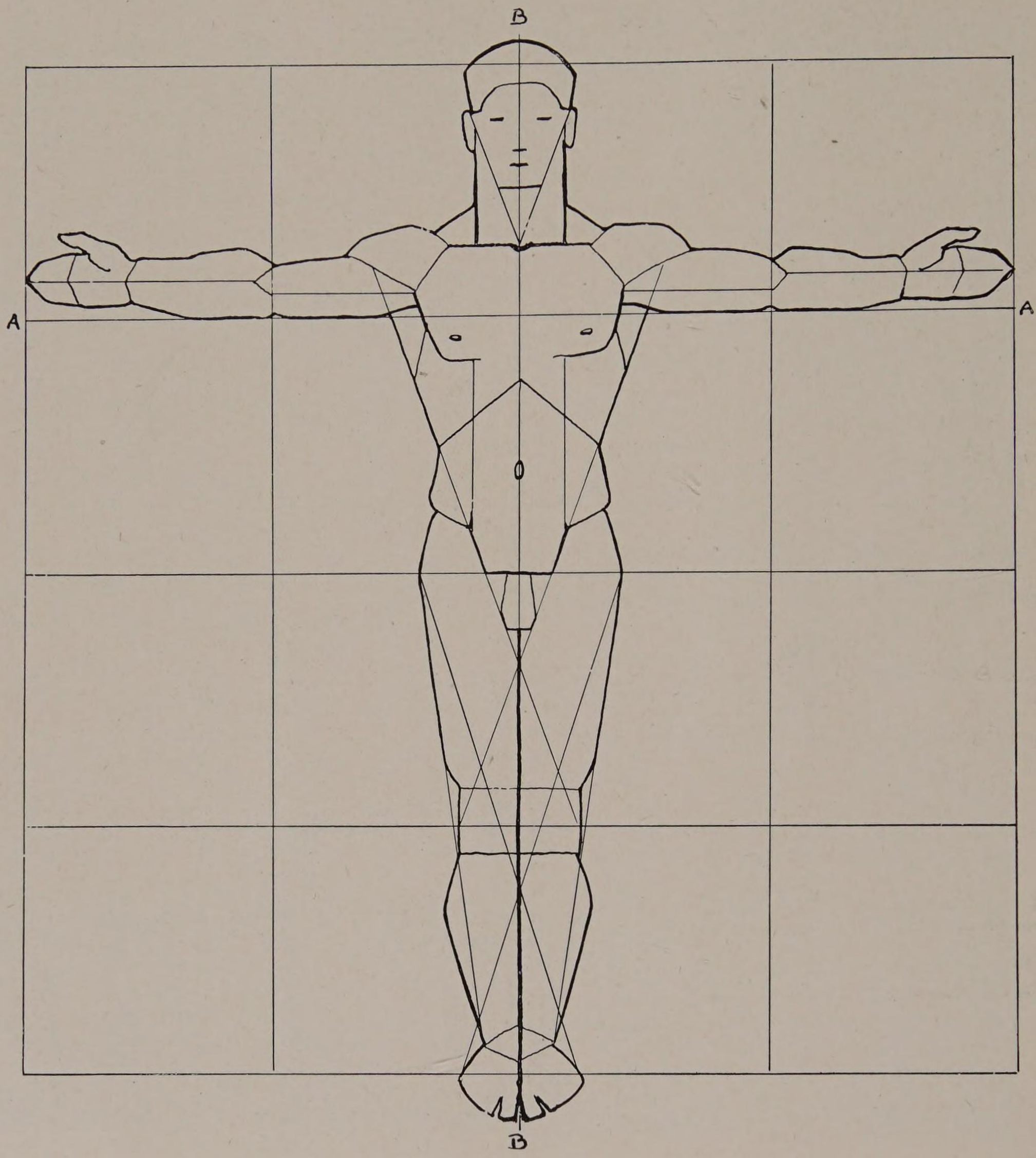


DIAGRAM 50
Man in a square: from finger tip to finger tip equals height

are inserted both along its posterior edge and down around its corner quite a distance toward the chin. Pulling upward on this lower maxillary, they naturally close the jaw and clench the teeth. From the lower corners of orbicularis oris, muscles pass to either side of the chin. Drawing down on these corners, they contribute to the "square-mouth" characteristic of crying. And lastly, there are two tiny, wedge-shaped muscles

in the center of the chin, frequently puckered when we wish to express doubt or stubbornness.

So we see that most of the face muscles are definitely influenced by our minds and moods. We all know that constant use develops a muscle, so if we continually use the corrugators of the brows, for example, or contract too often the sneering muscles which run from the sides of the nose to the upper lip, these grow until we are said to have a frowning or a supercilious face.

From the under side of the chin, various muscles grow back toward the hyoid bone of the throat and they all assist in opening the jaw and in swallowing. A rather thick layer of subcutaneous fat here, as well as the platysmal sheath, blends their forms together so that they need not be studied in detail.

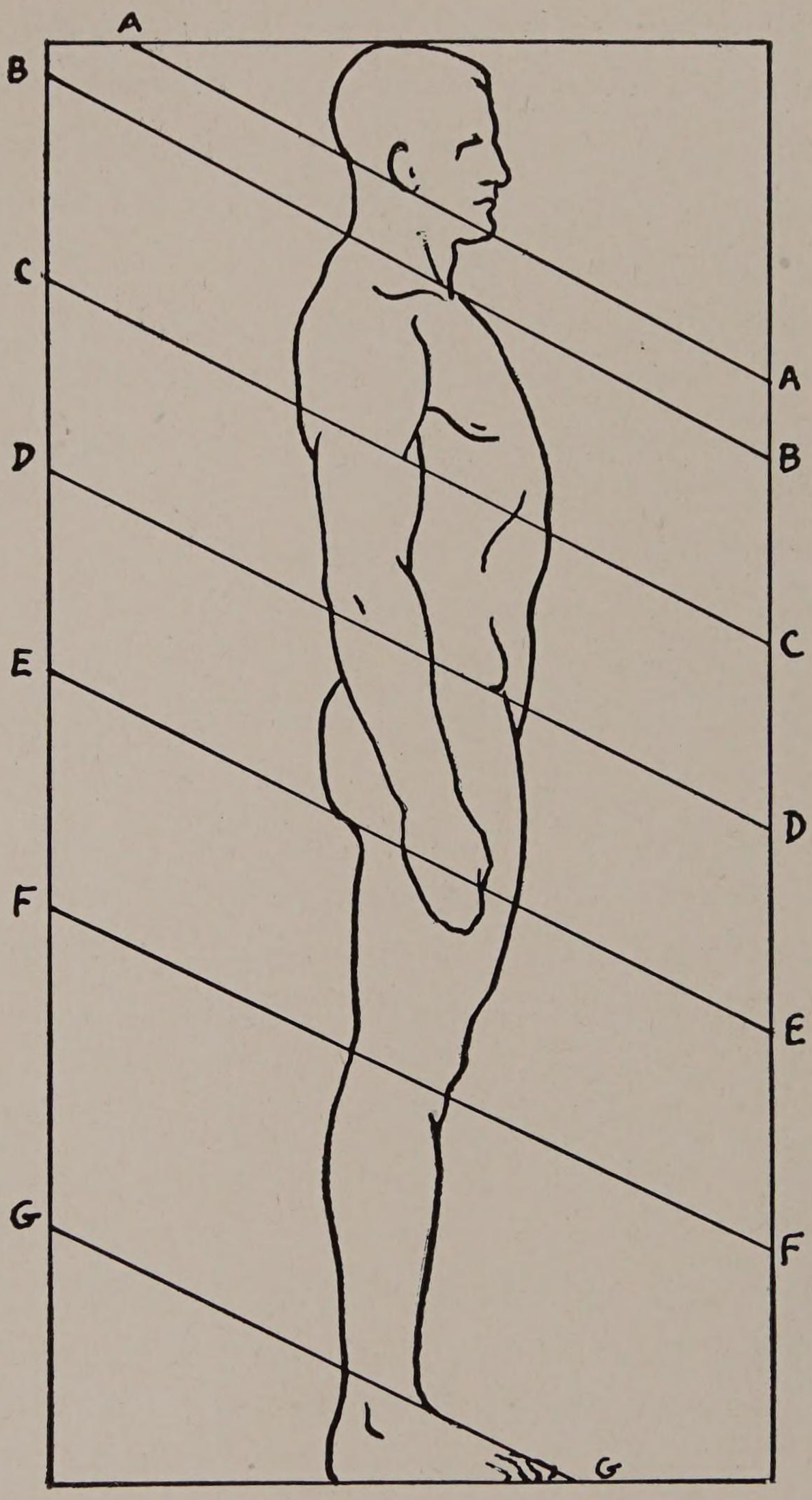


DIAGRAM 51*

Both the lower end of the nose and the ears are made of cartilage, incapable of movement but, in the case of the nose, pliable enough to be affected by surrounding muscles. The lower end of the nose and the shape of the nostrils vary greatly in individuals, but it should be observed that the holes of the nostrils are never round, as the tyro is apt

* Major *diagonal* directions: Line A-A, base of skull to chin. Line B-B, 7th cervical to pit of neck. Line C-C, direction of ribs. Line D-D, direction of anterior half of pelvic crest. Line E-E, gluteal fold to center of thigh. Line F-F, back to front of knee. Line G-G, upper surface of foot.

to make them, and that the wings of the nostrils are set as far back in the face as the tip projects from it. Thus, as seen from the side, the upper lip descends from the nose halfway between the tip of the nose and the back of the nostril. This and many other details of facial construction are more fully described in the chapter on the portrait bust.

Here we bring to a close this summary of the structure of the human body. The limits of this volume have precluded any detailed analysis and description. I have told only what, through many years of modelling and of teaching, I have found to be essential to an understanding of *the way the thing works.* One must know at least this much if one wishes to model a figure with any degree of accuracy and intelligence.

Among my readers will be some who feel all of this chapter unnecessary to the production of sculptured figures; and others who will resent my skimming so lightly over such important matters and who wish to delve deeper into the intricacies of anatomical construction. To the former my reply is easy: "Don't read it!" To the latter I heartily recommend such full and authoritative analyses as may be found in Sir Arthur Thomson's *Handbook of Anatomy for Art Students,* published by the Clarendon Press, Oxford, England; Dr. Paul Richer's superb series of plates, *Anatomie Artistique;* and George Bridgman's *Constructive Anatomy.*

A couple of diagrams which, after all this detailed analysis, may help to clarify the student's conception of the figure *as a whole,* are Diagram 50 (based upon Plate 71, reduced to simple geometric terms), and Diagram 51, which will, I trust, show why I am so insistent on the *diagonal directions* which characterize the profile figure. Note that all these slanting lines are absolutely parallel. They are obviously a part of nature's design and are not to be overlooked.

Finally, I give you two photographs of a particularly well-built man: one kneeling and one seated (Plates 72 and 73). It would be fun, I think, for you to test your new-found knowledge of anatomy by making large outline drawings of these poses and filling in the bony structure and muscles as has been done in the other plates.

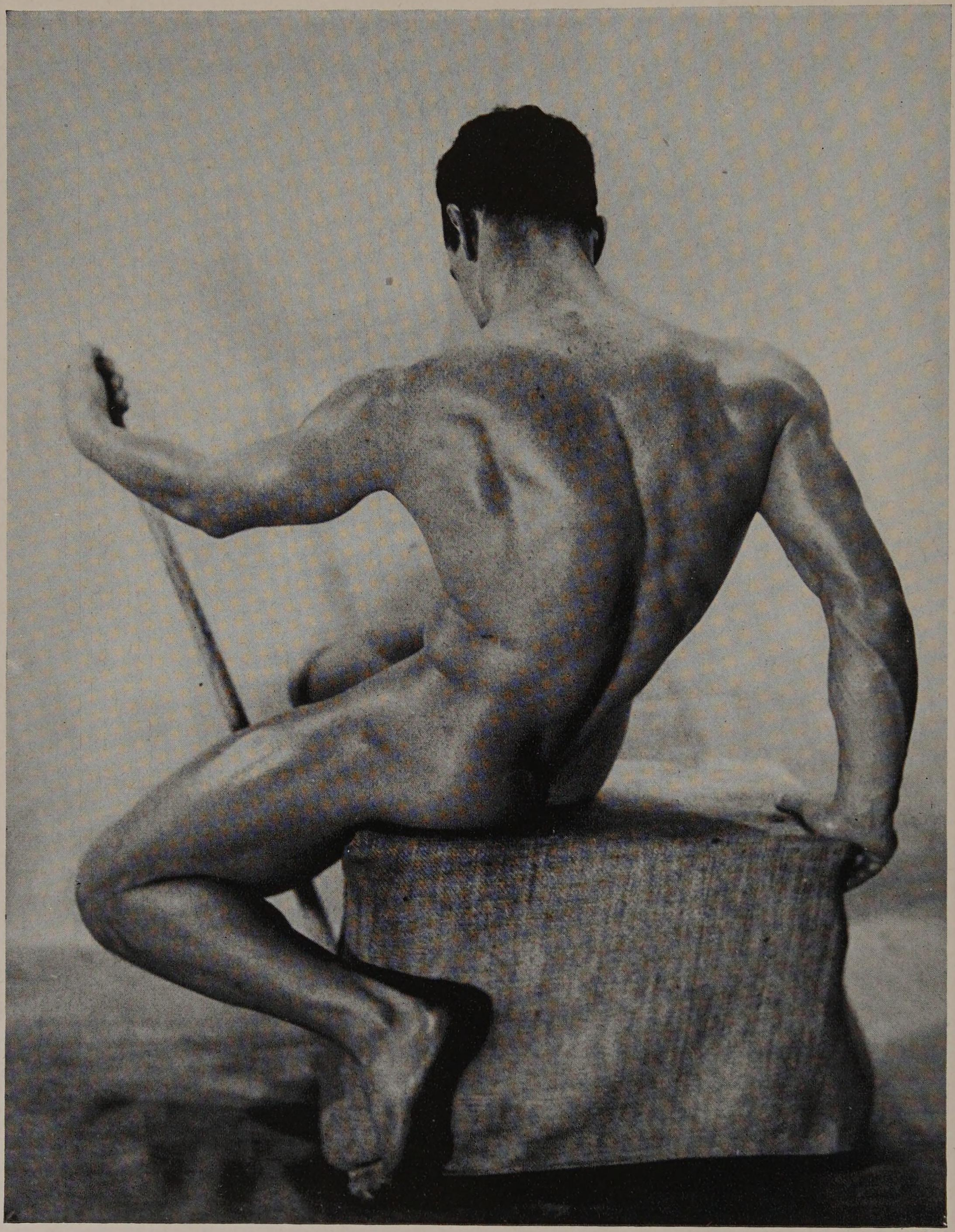
It seems that there are three distinct steps in the growth of one's understanding of anatomy:

1—*Learning* it so that you can readily analyze it on every part of the living model.
2—*Remembering* it so that without a model you can make a clay sketch of a figure in any pose.



Photo by Gebbé

PLATE 72. Kneeling Man, *Pulling on Rope*



Gebbé

PLATE 73. Seated Man, *Rear View*

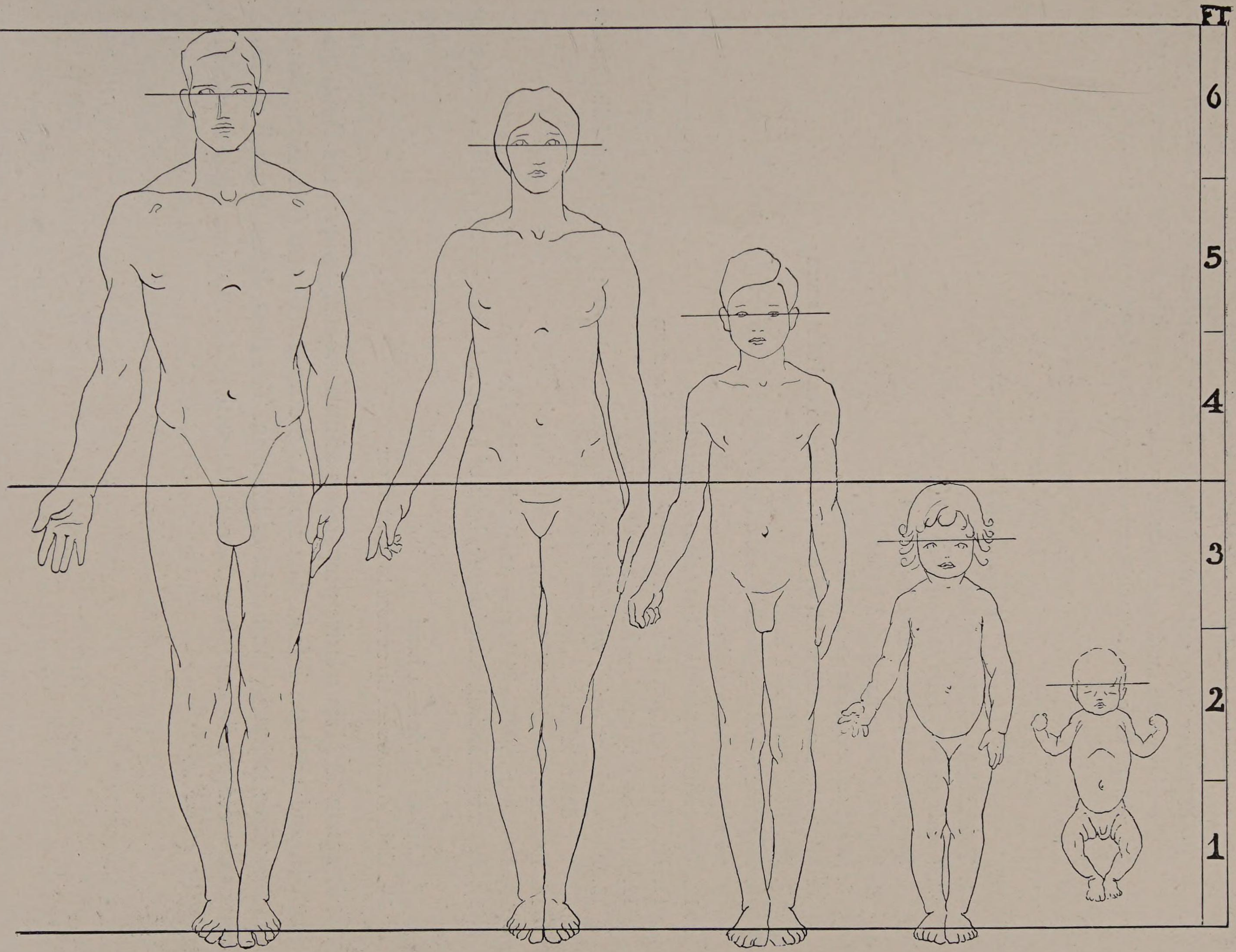


DIAGRAM 52

3—*Forgetting* it, or rather relegating it to the subconscious, so that whether you are working with models or without, you are free to *interpret,* by legitimate suppression or exaggeration, without breaking primary laws of nature or of art.

TABLE OF PROPORTIONS
In the adult male

(This should be memorized)

1. Total height = 7½ to 8 heads
2. Center of body falls at symphysis pubis
3. Symphysis to knee = knee to ground
4. Top of head to navel = 3 heads
5. Width of shoulders = 2 heads
6. Width of thorax = width of pelvis = chin to end of sternum
7. Height of pelvis = 1 head
8. Depth of pelvis = clavicle = scapula
9. Clavicle to anterior iliac spine = 2 heads
10. 7th cervical to posterior iliac spine = 2 heads
11. Pit of neck to symphysis = 7th cervical to tip of sacrum
12. Pit of neck to navel = knee to ankle
13. Elbow falls at waist; wrist falls just below great trochanter; middle finger falls halfway down thigh
14. Length of hand = ⅔ forearm
15. Length of foot = ⅔ leg = top back of head to chin
16. In straight-backed, seated figure, back of buttocks to knee = 2½ heads = shoulder to seat
17. Chin to nipple = 1 head
18. Chin to brows = tip of nose to front of ear

Diagram 52 gives relative proportions of man, woman, ten-year-old child, three-year-old, and newborn infant. The scale at the right indicates feet. Note that the child of three is just ½ the height of the man. The lines drawn through the heads mark their centers. In the infant the eyes are well *below* this line, while in the adult they lie *above* it.

CHAPTER VI

MODELLING FROM LIFE

OF course, modelling from life is what you have been doing ever since you began rolling clay balls and fashioning them into fruit forms. But in the artist's vernacular the phrase means, primarily, modelling whole figures from the nude. This is what practically every art school teaches and if you are able to do so you should join a class in life modelling. Every sculptor must know how to "put up a figure" whatever else he may, or may not, learn in a school. Unfortunately this branch of sculpture is so important and requires so many months and years of constant practice, that the average art school has little time to teach the student anything else; which is one of the reasons for this book. But it is excellent training and discipline for a student to mingle with his fellows, to learn by their mistakes as well as his own, to profit by their achievements and to drink in the criticisms of the master. Moreover, from a very practical point of view, it is far cheaper to share a model than to hire one for yourself alone. Good models demand at least a dollar an hour, if not more, and this mounts up if one is engaged for several weeks. Art schools usually engage a model for two weeks at a time. The model poses for three hours each day, taking a five-minute rest every half hour. This gives the student about thirty-six hours in which to build up a figure.

For the beginner it would be better not to work more than one week on the same pose. Frequent changes of pose and of model prevent the pupil from going stale on his work, and from trying to finish what should be mere practice studies. They also give him a far better general idea of the mechanics of the body in different positions and of the infinite variety of nature to be found in different models.

We shall assume, in this chapter, that you have a model all to yourself and for as long as you want him. I say "him" because in your first attempts you should employ

a male model, if only to put into practice what you have learned from the chapter on human anatomy. The model chosen for the demonstration in this chapter, and for some of the anatomical analyses in the last chapter, has a fine figure. He also knows how to pose, and if you think mere posing is easy, try it yourself before a mirror and see whether you can stick it out even one of those many half hours. If the model whom you engage is not entirely accustomed to posing it might be well to let him rest every fifteen minutes; otherwise his body will soon sag from fatigue and the life of the pose be lost.

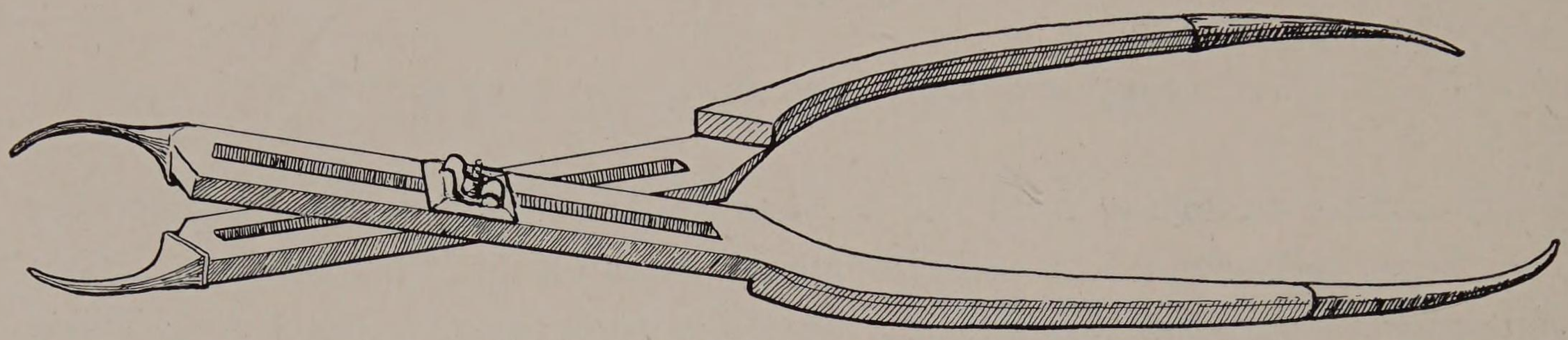


DIAGRAM 53

In a modelling class, especially, the number of possible poses is limited, if they are to be held long enough for each student to have a chance. As each new model assumes the same old poses the students set up a despairing cry. "Can't he do something different?" they wail. But the answer is, "Not under the circumstances." Figures in violent action may later be tackled in the privacy of one's own studio, where the model can rest every few minutes or can pose just a part of himself at a time. Rodin frequently had a number of models moving about his studio at the same time, walking, running, getting together in groups, sprawling about, or climbing here and there. But that was after he became a master and could do as he liked.

At the start, then, as we are not yet Rodins, we must choose a fairly simple pose for our model. Such a pose as the one used in this chapter is quite easy yet gives ample variety for study. One leg bears the weight; the other is relaxed; the pelvis faces in one direction while the thorax swings to the opposite; one arm is flexed, the other hangs naturally and the head is turned to give full expression to the upper spinal curves.

For your first life studies it is best to make a figure about thirty to thirty-six inches high. The one illustrated is thirty inches. This is large enough to enable you to work freely and to sense the bigness of the forms, yet not so large as to be unwieldy and

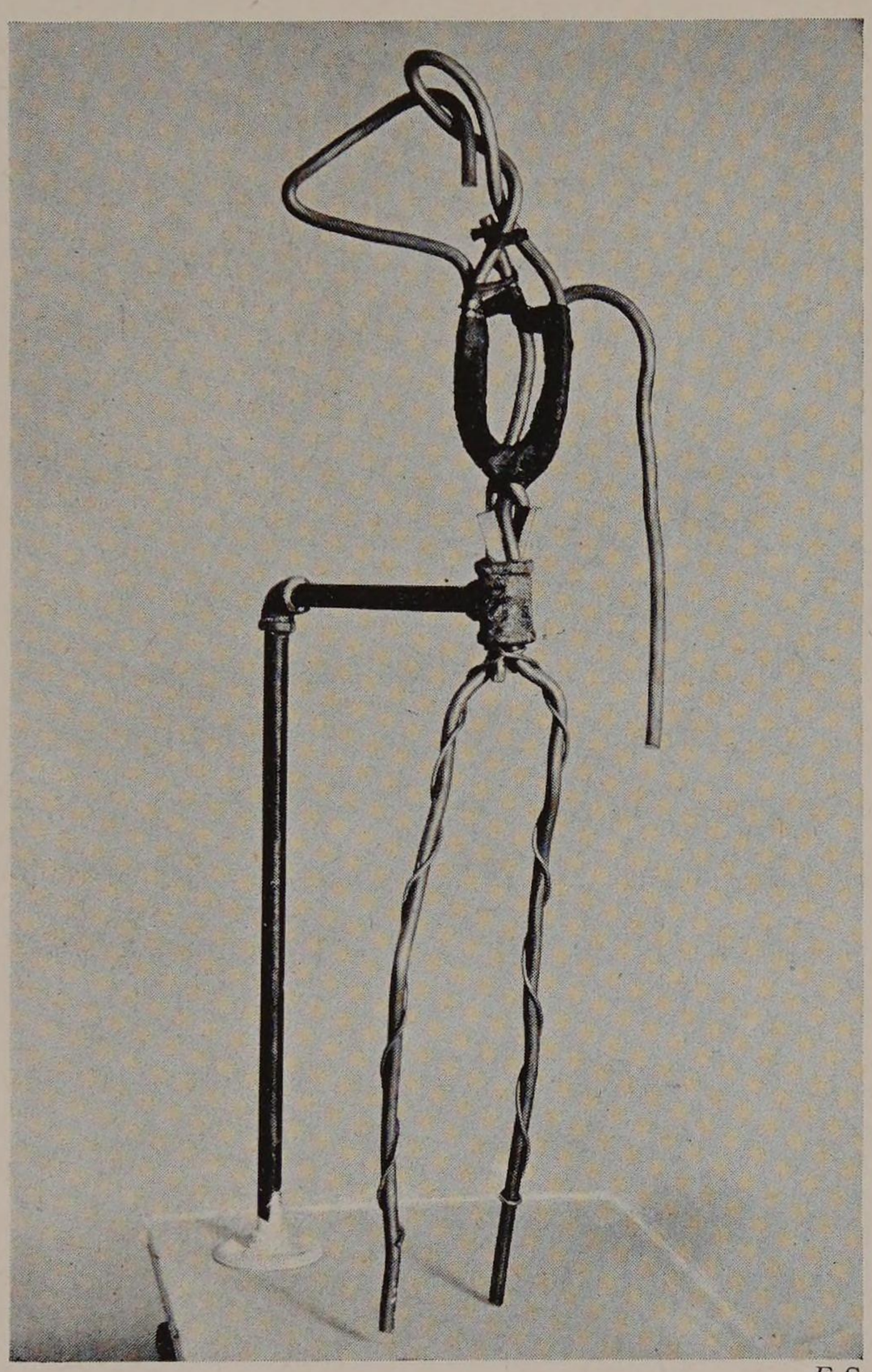
to cause hours of wasted time in merely packing on the clay. As it is not easy at first to adjust the eye to the difference in size between the living model and the clay, you should have on hand a pair of double calipers like the one shown in Diagram 53. The large end will measure a certain proportion on the model while the small end will show you what the proportion should be on your study. The adjustable screw which slides up and down in the middle groove will have to be moved this way and that until the correct scale has been determined. If, for instance, the man is 69 inches tall and your figure is to be 30 inches, adjust the screw so that the large end measures 11½ inches while the small end measures 5 inches. Then set the screw tightly so that it will not slip. Ink a line around it, also, to fix the place in case it should work loose after some use.

For life modelling, you will need a model stand as well as one for your own work. This should be about 18 inches high and about 3 feet square, with a revolving top, preferably round, which will roll easily on ball bearings. This stand must be sturdy enough to carry the weight of a man, and the ball bearings should be of good quality to roll smoothly under such a weight. The main purpose of this stand is to raise the model so that the *center* of him (not his head) is at eye level. Only from this viewpoint can the figure be seen *in toto*—equally important both below and above the center. Your own modelling stand should be about 3 feet high, or so adjusted that the hips of your clay model will also be at eye level.

Now comes the problem of the armature, or framework, for your figure. As we discovered in Chapter III, figures grouped solidly together in one mass could be made without inside support, but as soon as a single standing figure is attempted, the clay legs give way under the weight of the body above. The arms, too, being free, need strengthening. So, before we begin modelling, we create a sort of skeleton of lead or aluminum wire upon which we pack our clay. But as this wire must be more or less flexible, it, too, will collapse unless supported. So instead of *standing* this skeleton upon its feet, we *hang* it from an iron rod. This "gibbet" may be made from a single rod of iron bent by a blacksmith or garage mechanic to the required shape. Or it may be made of 1-inch iron pipe in two sections—the upright and the horizontal joined by an elbow. To the lower end of the upright is screwed a flange with which to attach it firmly to the board. To the outer end of the horizontal is screwed a T to which the central portion of your skeleton will be fastened. Any plumber can make your iron pipe gibbet if provided with a drawing and dimensions. Make the horizontal about

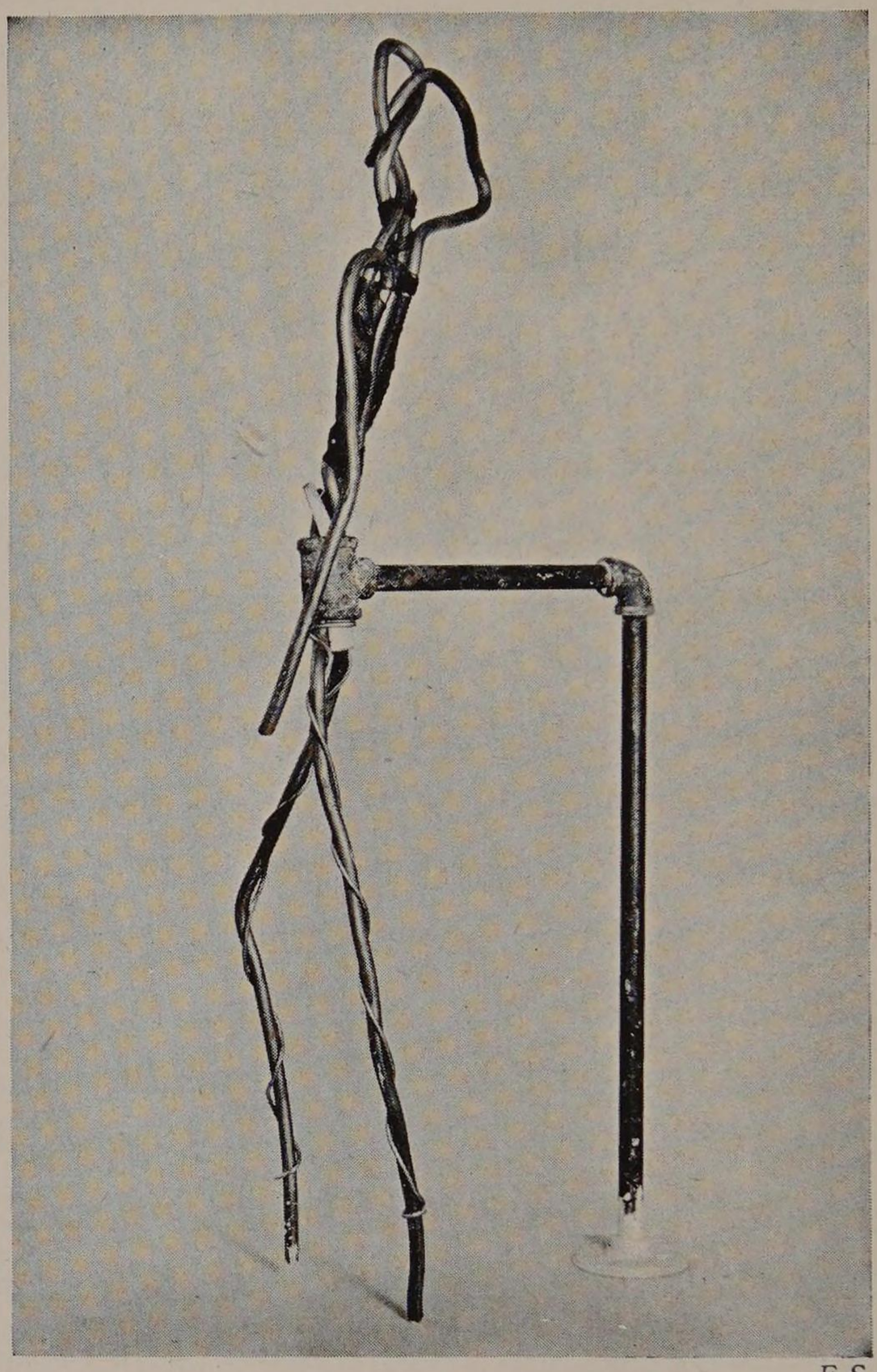
9 inches long. If it is longer, it may sag with the weight of the figure. If shorter, it will interfere, when you try to model the parts near to it.

For a 30-inch figure the upright should be about 19 inches high to allow for a 2-inch clay base upon which your figure will stand. The center of the body (symphysis) will



E.S.

PLATE 74. Figure Armature, 1



E.S.

PLATE 75. Figure Armature, 2

come just below the T, while the thorax, arms and head will be above. The legs hang from the horizontal rod, thus relieving the ankles from all weight above (Plate 74).

If you are using clay, the board on which you are to model should be made of double- or triple-ply wood, rather than of a single thick piece, to prevent warping. It should also be reinforced underneath by a couple of cleats. It is well to paint the board with asphaltum or other waterproof coating. Besides the iron support you will need about five or six feet of ¼-inch lead pipe or wire (pipe is hollow; wire is solid),

also a spool of fine copper wire, one of lead solder, and a roll of electric wiring tape.

Shellac your gibbet to prevent rust. When it is thoroughly dry, set it up on the board with the bottom flange at one corner of the board—*not in the center*. The T at the end of the horizontal should be above the center of the board so that the figure will stand squarely in the middle. This position of the iron support brings the horizontal into the hips at a tangent, so that it comes in the comparatively uninteresting fleshy part of the gluteal region, rather than in the sacrum where so much significant modelling and construction are to be found. Screw the flange firmly down to the board and then measure off your wire. Cut off a piece several inches longer than twice the height of the figure-to-be: about 6 inches for a 30-inch figure. These extra inches will be taken up in twisting the wire at neck and waist, spreading it out at thorax and at hips after it has been passed through the T. The two legs should just clear the board.

After you have twisted your wire and passed it down through the T, take the calipers and measure the total height of the armature. From board to top of head it should measure about 31 inches, allowing 2 inches for clay on top of head and a 2-inch base. You will probably find that the wire moves this way and that inside of the T. All movement must be stopped here as this must be the one solidly fixed part of your armature. A shorter length of wire, representing the spine, may be forced into the top of the T to make it tight, and small wooden wedges hammered in from above and below will complete the job (Plate 75).

For the arms, measure off quite a long piece because, instead of bringing the wire straight across the shoulders from one arm to the other, it is better to make a deep loop of it down the thorax and up again. In this way you will be able to alter the position of one arm without moving the other. Adjust this wire carefully, then bind to the central part of the armature with copper wire, electric tape or twine. Bind as tightly as possible, for nothing is more discouraging than to feel one's armature wabbling inside when one's figure is halfway toward completion.

As the lower limbs will have heavy masses of clay on them which tend to slip down on a smooth wire, it is well to prevent this by twisting some lead solder about the two leg wires (Plate 75).

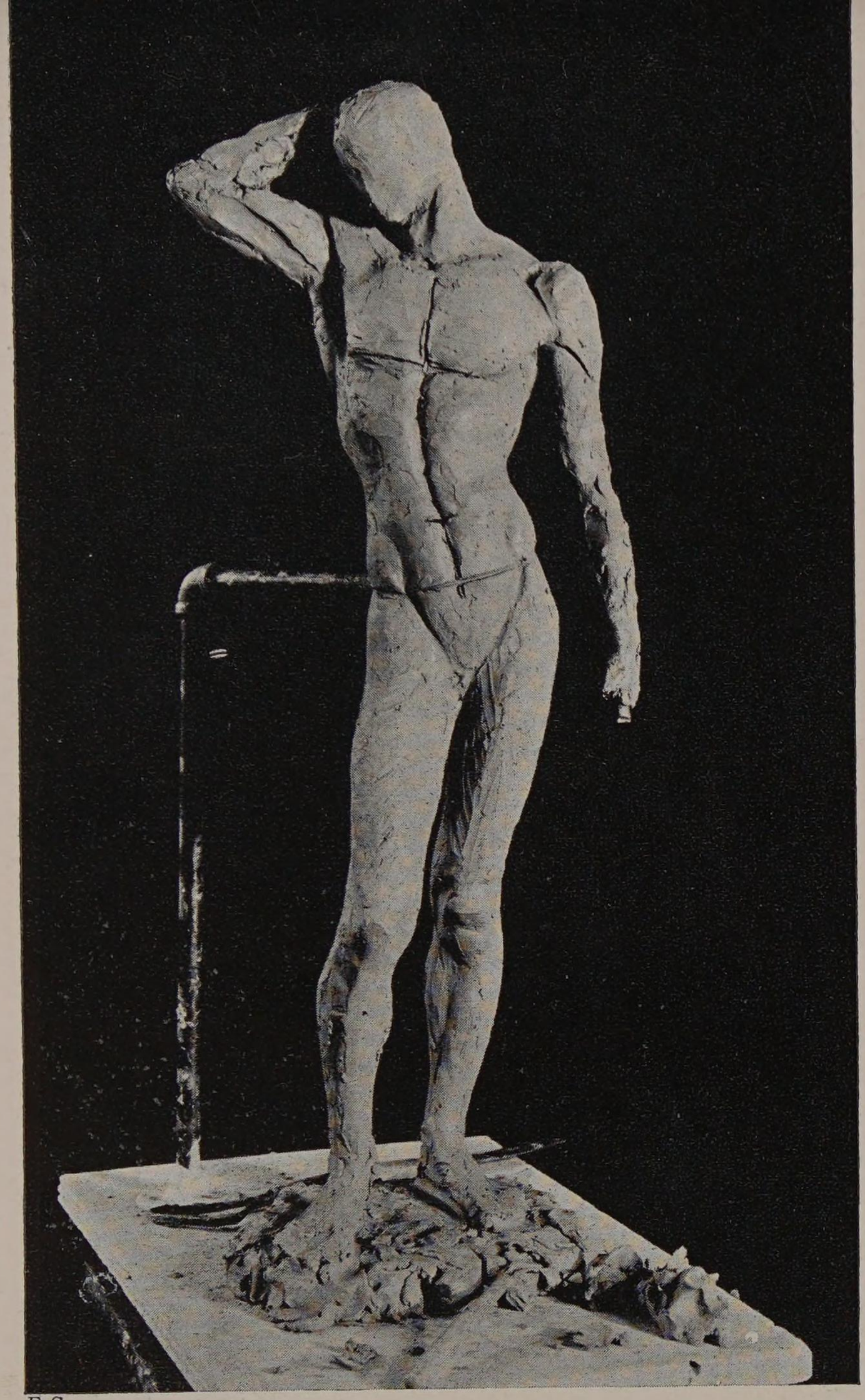
Before putting any clay upon your armature, build up a *level* 2-inch base for your figure to stand upon. This is important, for most of your measurements will be taken from it upward. If your clay base is not level, your measurements will be inaccurate and the feet of your figure will not stand firmly upon the ground.

Now, ask your model to resume the pose and take a few general measurements. Place one point of the calipers close to his foot and measure the distance up to symphysis. Squeeze a little clay upon your armature at this point and mark that measurement with the small end of the calipers. A match inserted here in the clay will give you a fixed point. Then measure from symphysis to pit of neck, to top of head, to knee, etc., marking these points in similar fashion. From the back, measure also from base to top of gluteal cleft and from this to the seventh cervical vertebra.

Besides measuring these important points you should take a plumb line (a lump of clay squeezed upon the end of a long string will suffice), and make sure that your figure is plumb. In such a pose as the one illustrated most of the weight is borne by the left leg; therefore the pit of the neck should be in a perpendicular line with the inner anklebone of that leg. Face your model, holding the plumb line at arm's length and in line with the pit of his neck. Notice that it falls at its lower end against the inner ankle. See that your armature trues up in the same way. From the side you will find that the seventh cervical button is in a perpendicular line with the outer anklebone and from the back it is again in line with the inner. Only if you get this fundamental "stance" at the start will your figure look rightly balanced. Of course, if you have chosen a pose in which the weight is distributed equally between the legs, the central line will fall, not at the ankle, but halfway between the two feet.

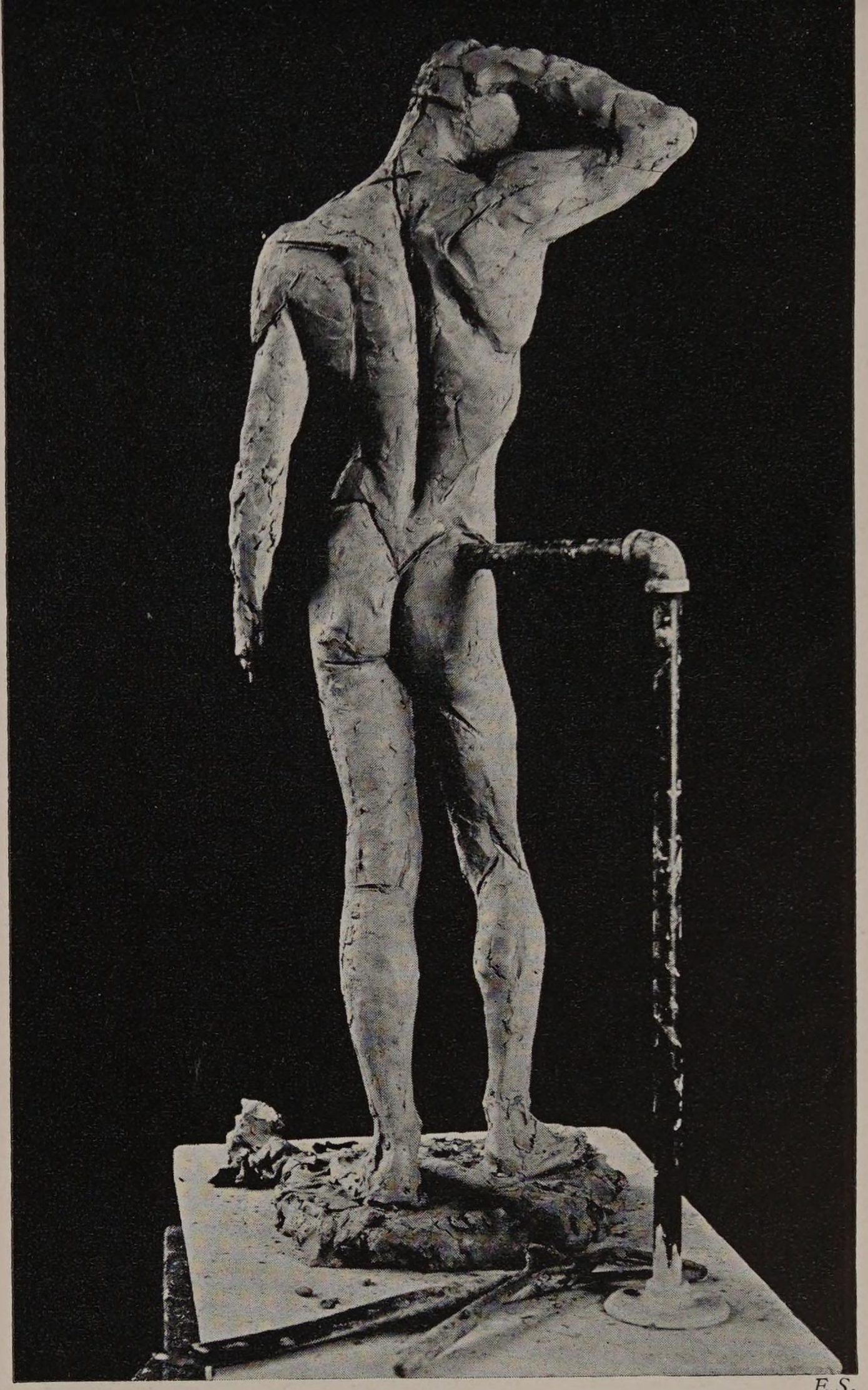
Exaggerate rather than minimize the action in your armature. Remember how little there is, after all, of the straight "up-and-down" in a living body. To make your dead clay live also, you must accentuate every direction that tends from the perpendicular or the horizontal.

Now begin packing on the clay, working out from the torso to the extremities. Pack it especially solidly around the waist so that there will be no air holes to weaken your foundation. As soon as you have enough clay to draw on, state in bold terms the direction of the spine. With a tool draw a sharp line down the back and a corresponding one down the front as far as the match peg you inserted earlier to indicate symphysis. Once this central line is established, proceed with the massing-in of the thorax and the pelvis, noting the differences in plane and direction of these two boxes. Find the two anterior iliac spines and draw a line from one to the other at right angles to your central line, as in Plate 76. This will indicate the swing of the pelvis. The crest on the side of the relaxed thigh will always be lower than on the other side, which thrusts up as it bears the weight. In the back, establish the direction of the



E.S.

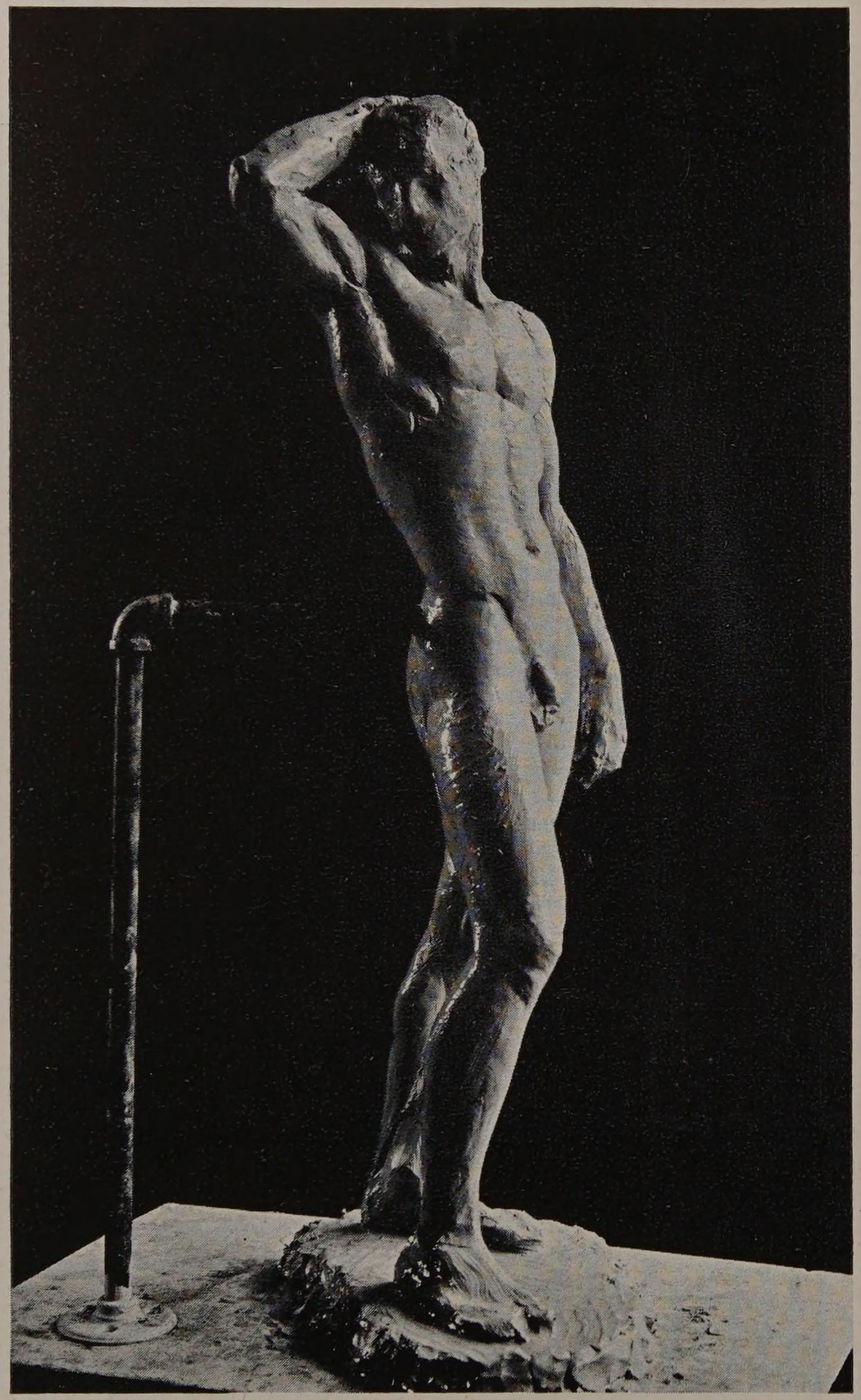
PLATE 76



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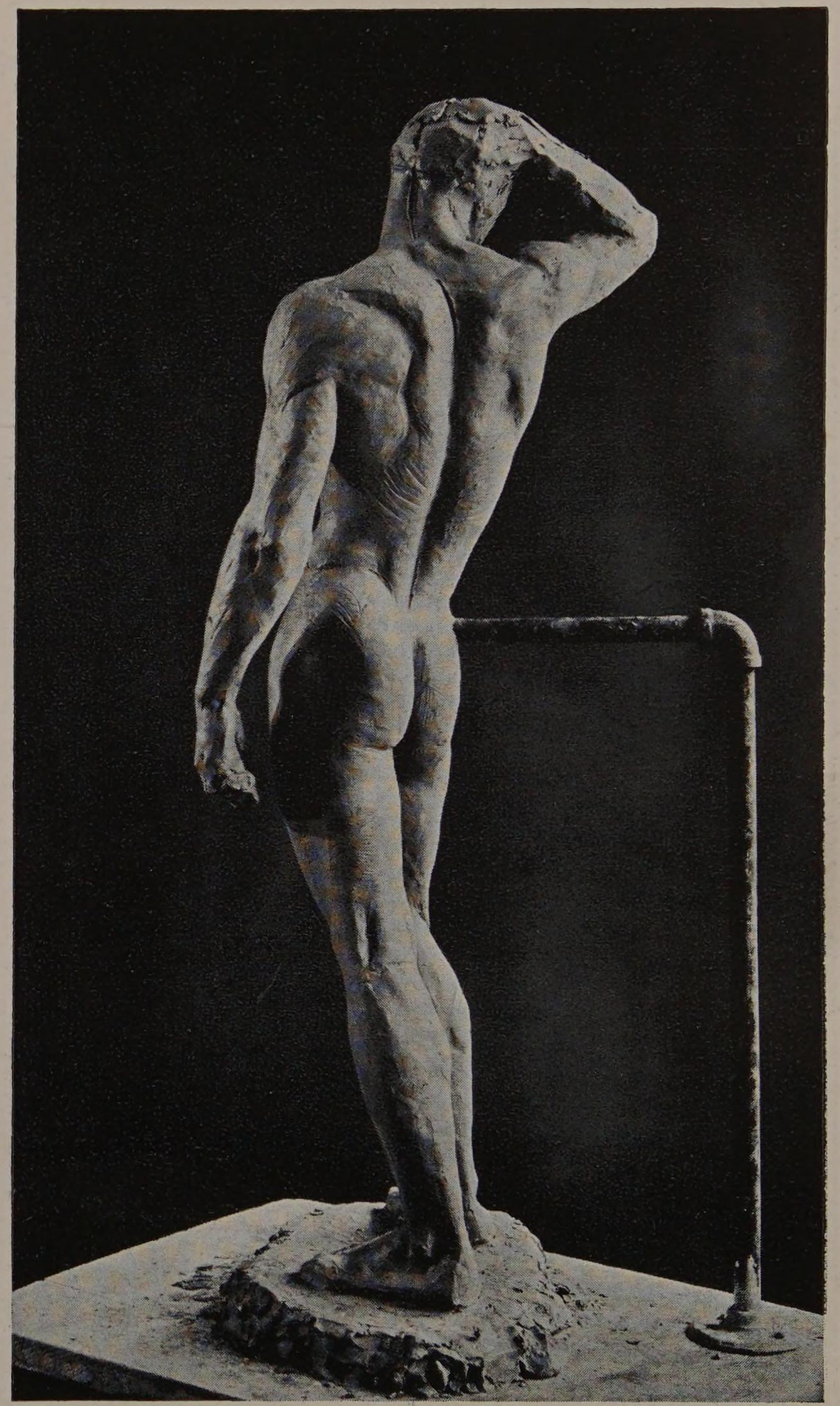
PLATE 77

Establishing the Main Directions and Masses



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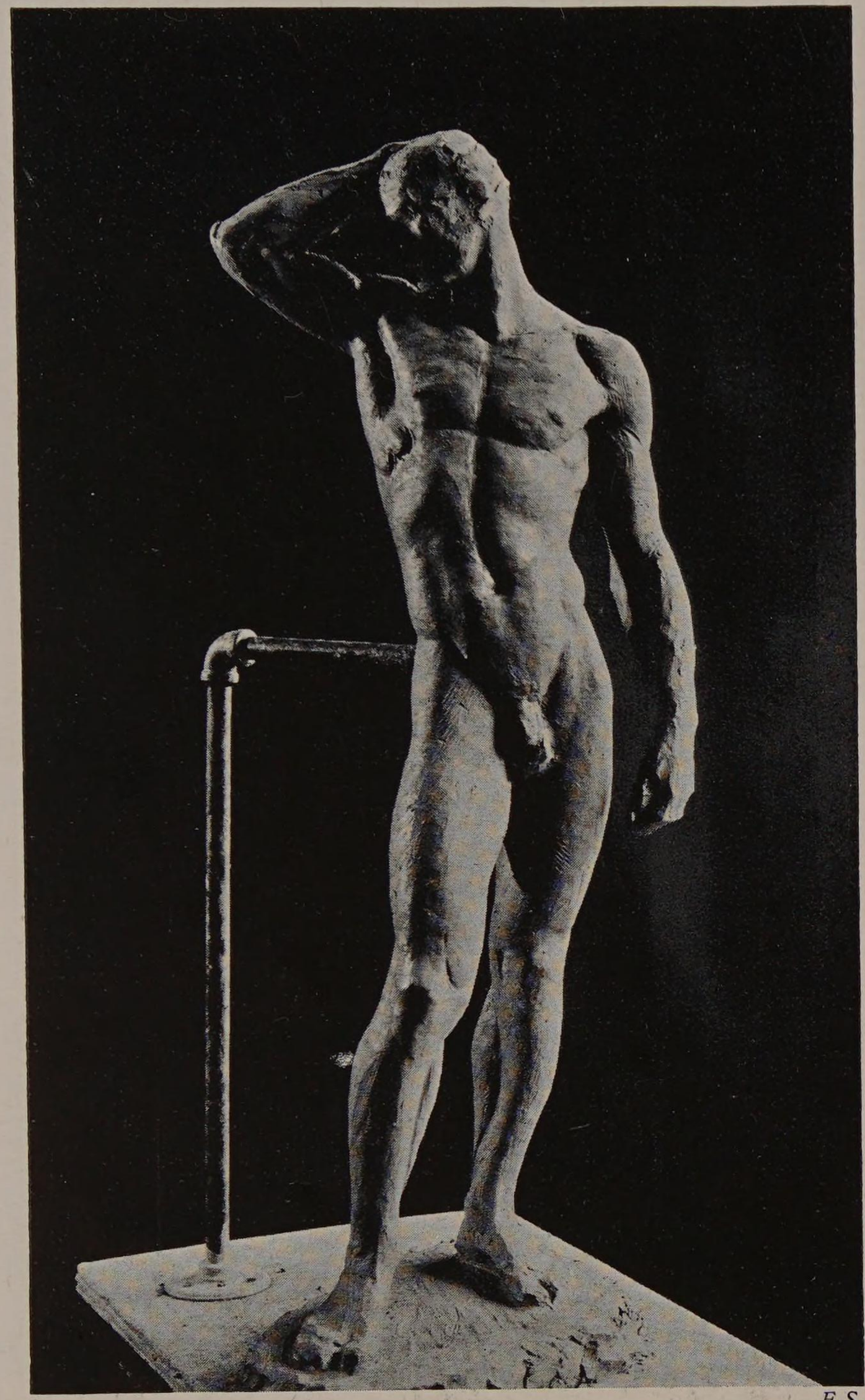
PLATE 78



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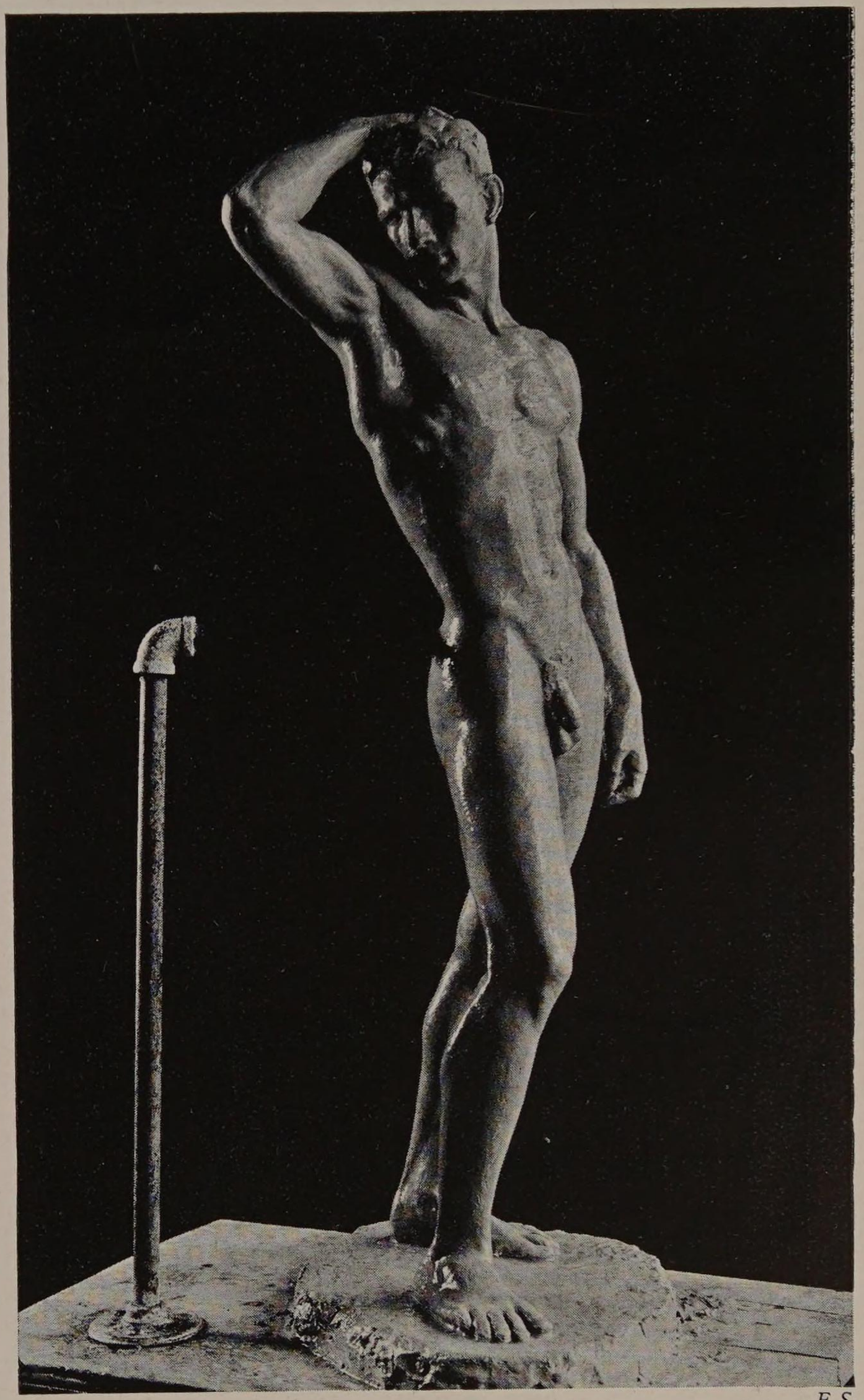
PLATE 79

Enriching the Modelling



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PLATE 80. Enriching the Modelling



E.S.

PLATE 81. The Figure Nearing Completion

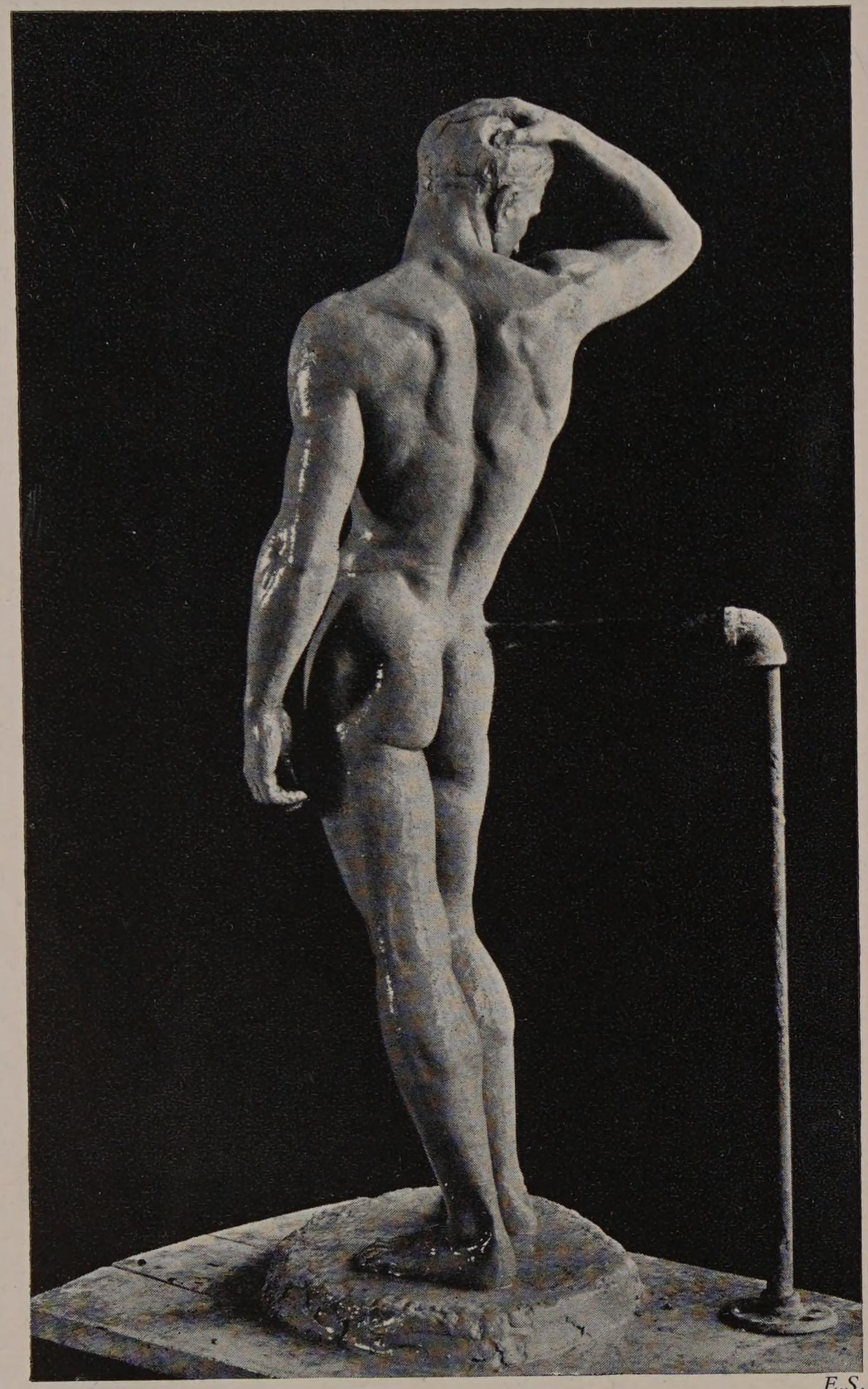
shoulder blades and all such bony parts by other clearly defined lines (Plate 77). As you proceed, take further measurements with your calipers: from symphysis to such parts as the acromion processes, the knees, the top of the head. Measure from shoulder to elbow, from elbow to wrist and to the tips of the fingers. And most especially measure from ground to both knees, for the chances are that you, like everyone else, will set the knees too low and not leave enough room for leg and foot.

For the first day or two, turn both your model and your work every five minutes. Never concentrate long on any one part lest you lose the sense of the body as a whole. Get the entire construction before you begin to model the individual forms. Keep going as far away from your work as possible. Place model and work together at one side of the room and from the other side give the two careful and searching study. Five minutes spent in such analysis is often worth five hours of close-up modelling.

Saint-Gaudens, during his last illness, directed his assistants from a couch at the far end of his studio. One day, after watching them for awhile in silence, he remarked, "I am going to invent a machine." The assistants all turned around. "It will have a big hook and strong springs," he continued. "The hook will be fastened to your belts and every three minutes the springs will jerk you back to this end of the studio and hold you here for five minutes, so that you can *see* what you are doing." This was a sound lesson and duly taken to heart by those young assistants, many of whom have since become distinguished sculptors.

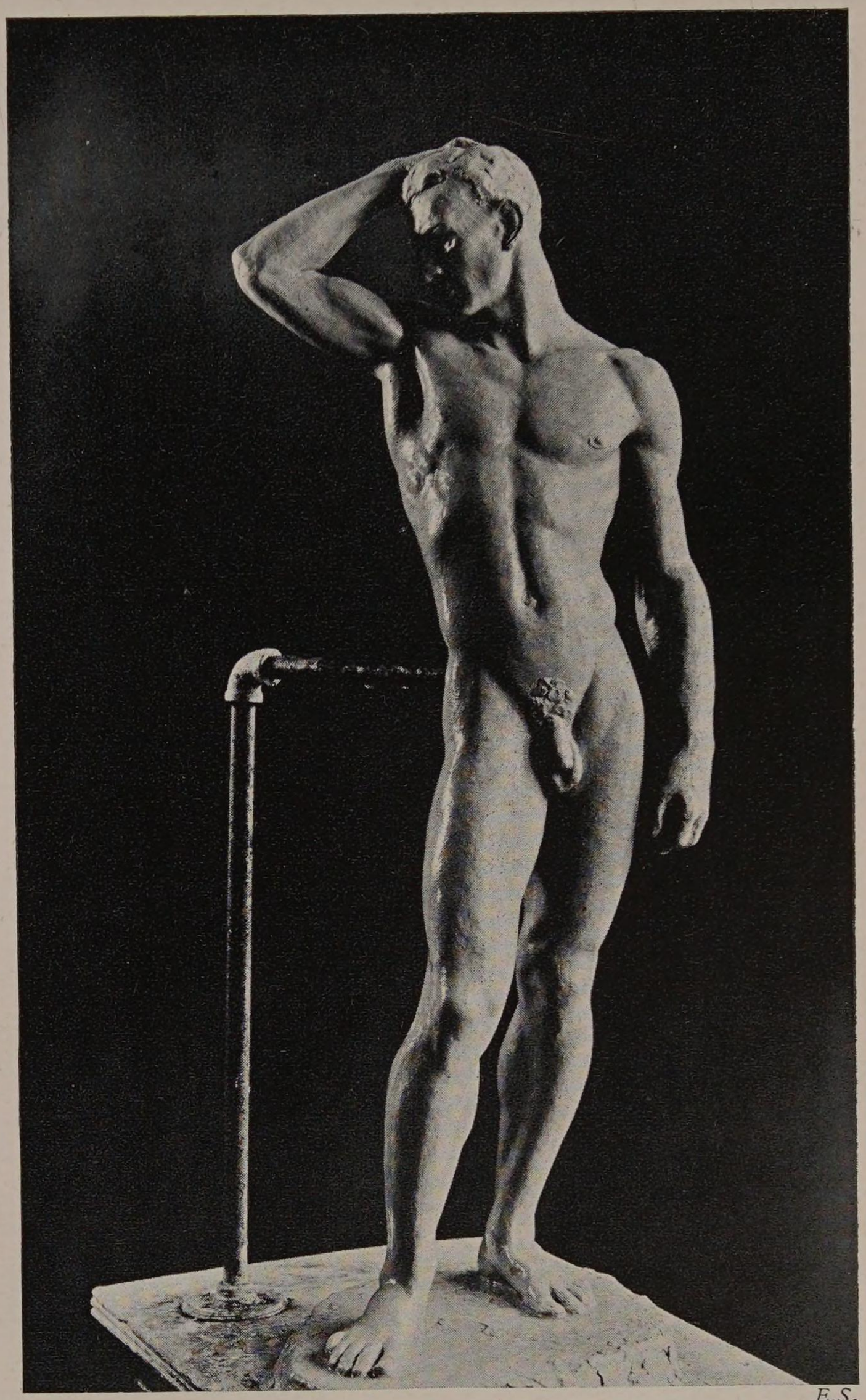
When you are working on the side view of your figure, keep in mind those dynamic *diagonal* directions of thorax, pelvis, etc., which were mentioned in the chapter on anatomy. Note too, how greatly the body curves backward and forward through an imaginary perpendicular line. It is anything but straight. Note in Plates 78 and 79 how the entire thorax and shoulders swing backward from the hips and how that backward thrust is supported below by the backward-thrusting leg and heel which carry the weight.

The spine is not the only place where we find the elongated S curve. Note in profile the line that flows down the front of the thigh, back through the knee and then curves forward from the calf to the instep. See in the front view (Plate 80) the central swinging line which ripples from side to side and back again all the way from head to foot. This is the living line of all growing things, from a blade of grass to man. Naturally you don't want such curves alone. There are plenty of flat planes and sharp accents in the body to counteract and strengthen them, but the swing of your figure



E.S.

PLATE 82. The Figure Nearing Completion



E.S.

PLATE 83. Completed, *Front View*

should come first. After you have that, search for the hard thrusts of the bony structure at such points as shoulder, elbows, great trochanter, knees and ankles and make the most of them, using flattened surfaces and planes wherever the bone comes near the surface. Notice, too, how nature almost always connects two great curved masses, such as thorax and hips (Plate 82), with a strong bridge—in this case the great erector muscles at the small of the back.

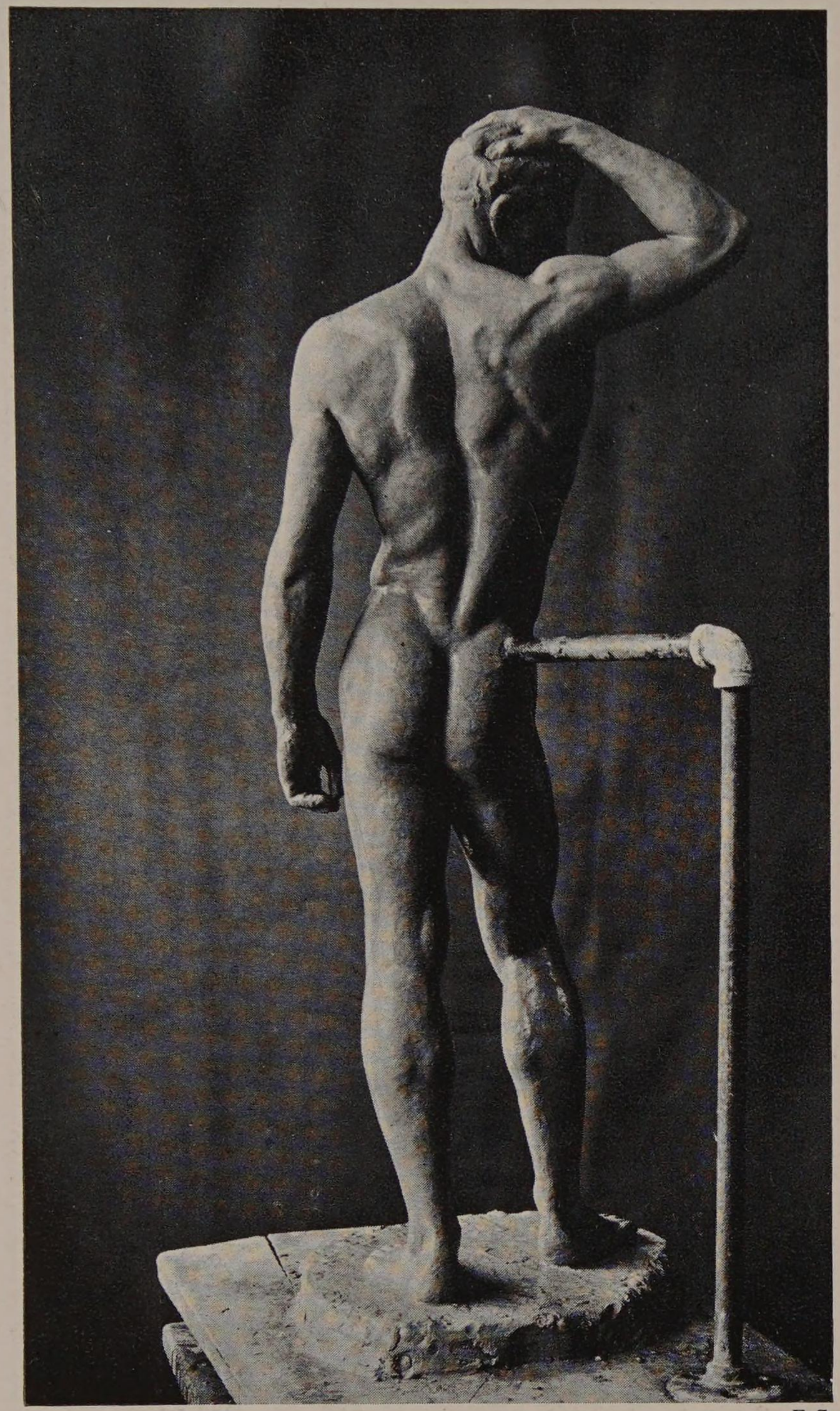
Now that your figure is beginning to take shape let me remind you of something too often forgotten by the beginner; namely, that there is exactly the same *bulk* on either side of the median line of the torso. The *shape* varies according to the pose, but the bulk must be equal on the two sides. If the thorax thrusts outward on one side, it must sink in on the other side; if one great trochanter forms a projection (in this demonstration, the left one), the other sucks inward, drawing the attaching muscles in with it.

Almost from the start, lay on your clay as much as possible in the shape it will eventually be, defining the outlines of the muscles clearly with decisive strokes of the tool. Later on, with softer clay, you can pull this anatomical study together wherever you wish. And until this last stage is reached, do not put on too much clay anywhere. Remember that modelling is a continuous process of building up, of superimposing clay upon clay until the final bulk is achieved.

For want of more exact terms we speak of the front, sides and back of a figure, but as you work you will find how difficult it is to decide just where one stops and another begins. The external oblique muscles swing up across the waist to the back of the ribs; the great latissimus muscles, though starting at the very center of the back, twist forward around the ribs. Sartorius, though starting at the anterior iliac spine, curves around to the back of the knee. We can plainly see the inner calf muscles from the front view of the leg although they lie behind the tibia. Such spiral formations are all a part of the rhythm of the living body.

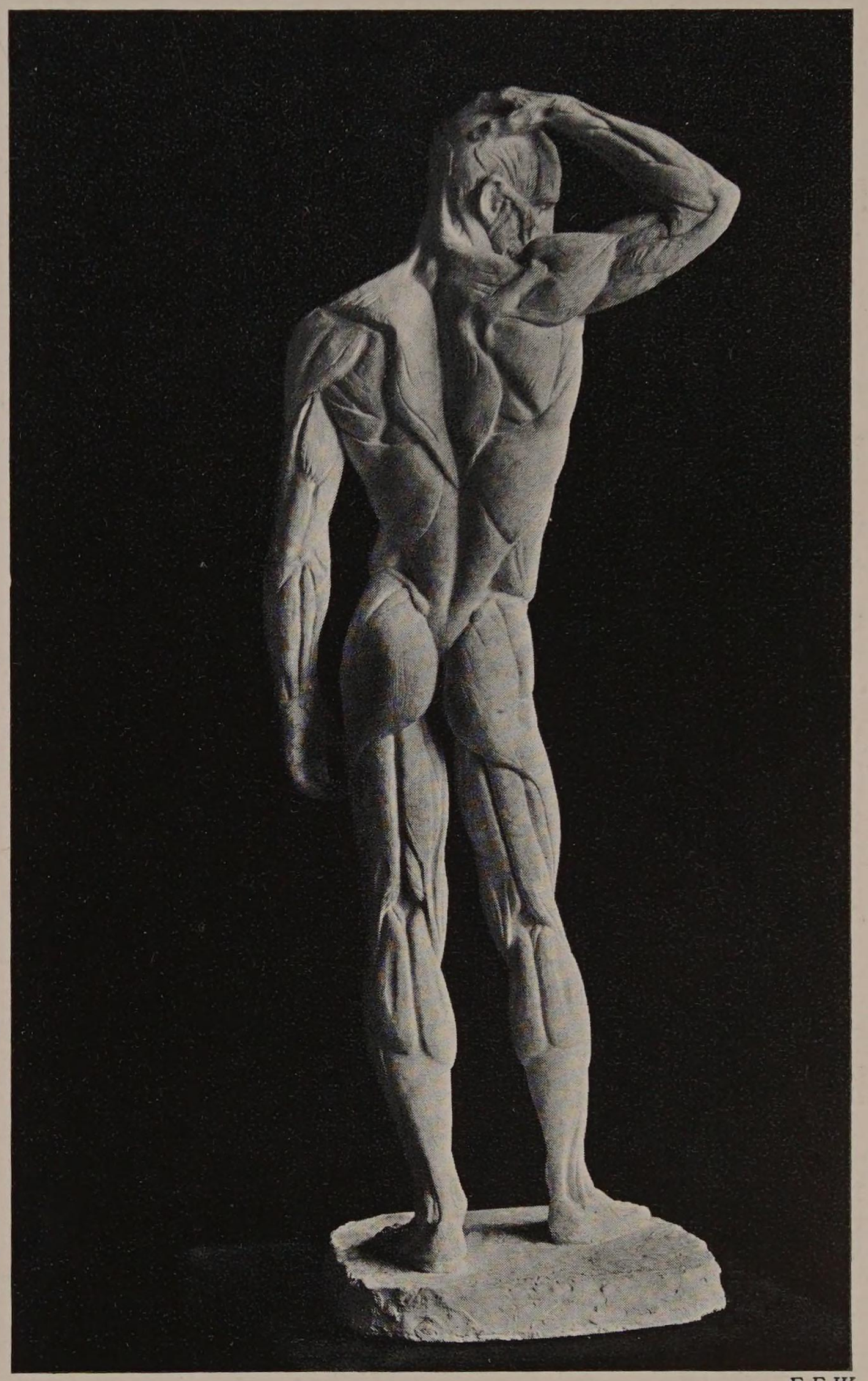
Be careful in blocking in the head of your figure to establish first and foremost its attachment to the spinal column at the back. Remember that the base of the skull must be at right angles to the neck vertebrae. The direction of these controls the direction of the box above. Treat your head at first as though it *were* a box—profile and back of skull parallel as they would be in such a case.

I have found that, in general, students are apt to get their large body masses out of proportion because they do not continually look from one side to the other of these



E.S.

PLATE 84. Completed, *Back View*



F.E.W.

PLATE 85. The Figure Anatomized

forms. While working on one side of torso or thigh, keep looking across to the other side in order to "size up" the entire form instead of just the portion on which you are working. Frequently, also, crouch way down under your model so that you may better appreciate the cross sections—his third dimension. A worm's-eye view of his rib basket and diaphragm will often be far more revealing than a direct view from the same level.



DIAGRAM 54

In your search for the significant direction of the forms, you will have noticed that the "straight" leg upon which his weight rests is actually anything but straight. The main line of the thigh swings inward from great trochanter to inner condyle at knee, breaks, then starts again at the outer condyle and swings inward to the lower end of tibia (Diagram 54). Unless these varying directions are appreciated, the leg will look hopelessly wooden.

Frequent radical changes in the direction of your light are most helpful. If you are working in window (or side) light, change about from one day to another, having the light come from one side on one day and from the opposite side on the following day.

The foregoing paragraphs with their repeated admonitions of what to do and what not to do will be but tedious reading unless you use them simply as a reference by which to check your work as it progresses. The points stressed are typical merely of what a master would probably look for in criticizing your work. None of them can, in the least, convey the sense of elation you may hope to experience when, for the first time, you set out to interpret the human figure. The sheer fun of modelling and the delight you will find in studying the living figure will amply compensate for all the difficulties, and for the discipline which you must constantly exercise over your eyes, hands and mind.

In Plate 85, the figure has been anatomized and cast in plaster. I believe that this anatomical figure, modelled from life, is the clearest and most helpful cast available to the student.

CHAPTER VII

WOMAN AND CHILD

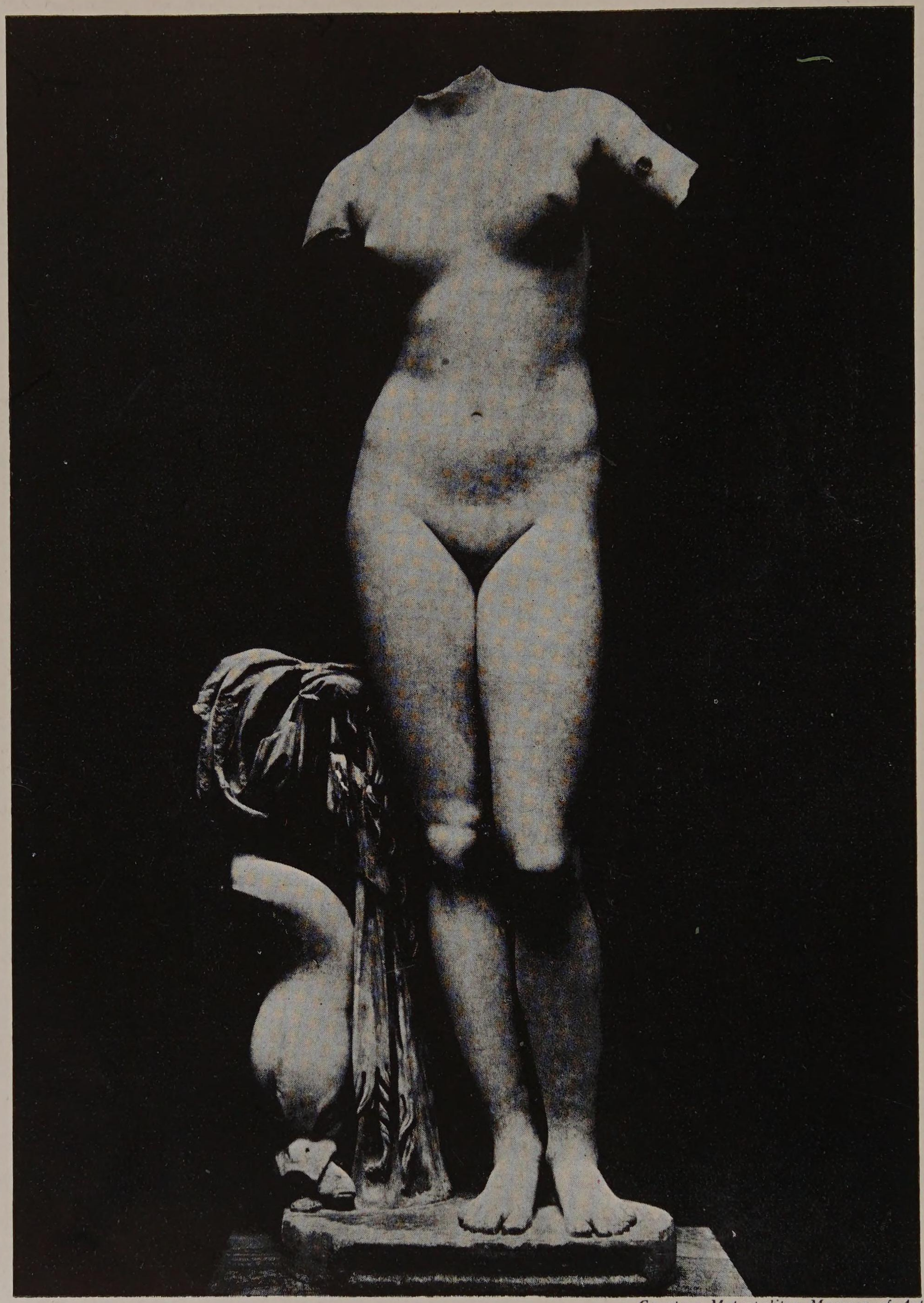
THE beauty of a woman's body may be ascribed to two fundamental qualities which have already been stressed in this book. First, the prevalence of the S curve, her bones and muscles being more delicate than man's, and being smoothly blended by a layer of fat under the skin. Secondly, the fact that, with its greatest width falling near the center, her whole body seems better balanced than that of man, which, with broad shoulders and narrower hips, is somewhat top-heavy as a purely geometric form.

Walter Crane, in his penetrating little book *Line and Form,* shows us how the graceful feminine body was the prototype of the Greek vase (Plate 87). Indeed, all the analogies which he depicts in this page of drawings are full of stimulating interest to the student.

For many a year, the Venus of Milo has been the accepted standard of womanly perfection and no one can gainsay her gracious nobility. Yet I venture to express a personal conviction that had the Venus of Cyrene (Plate 86) been discovered at the same time, she, and not the Venus of Milo, would have become our standard of perfection. Slimmer and less matronly, with long, strong legs, almost boyish torso and lovely young breasts, she stands firmly and simply, with none of the prudish affectations of the later Venuses.

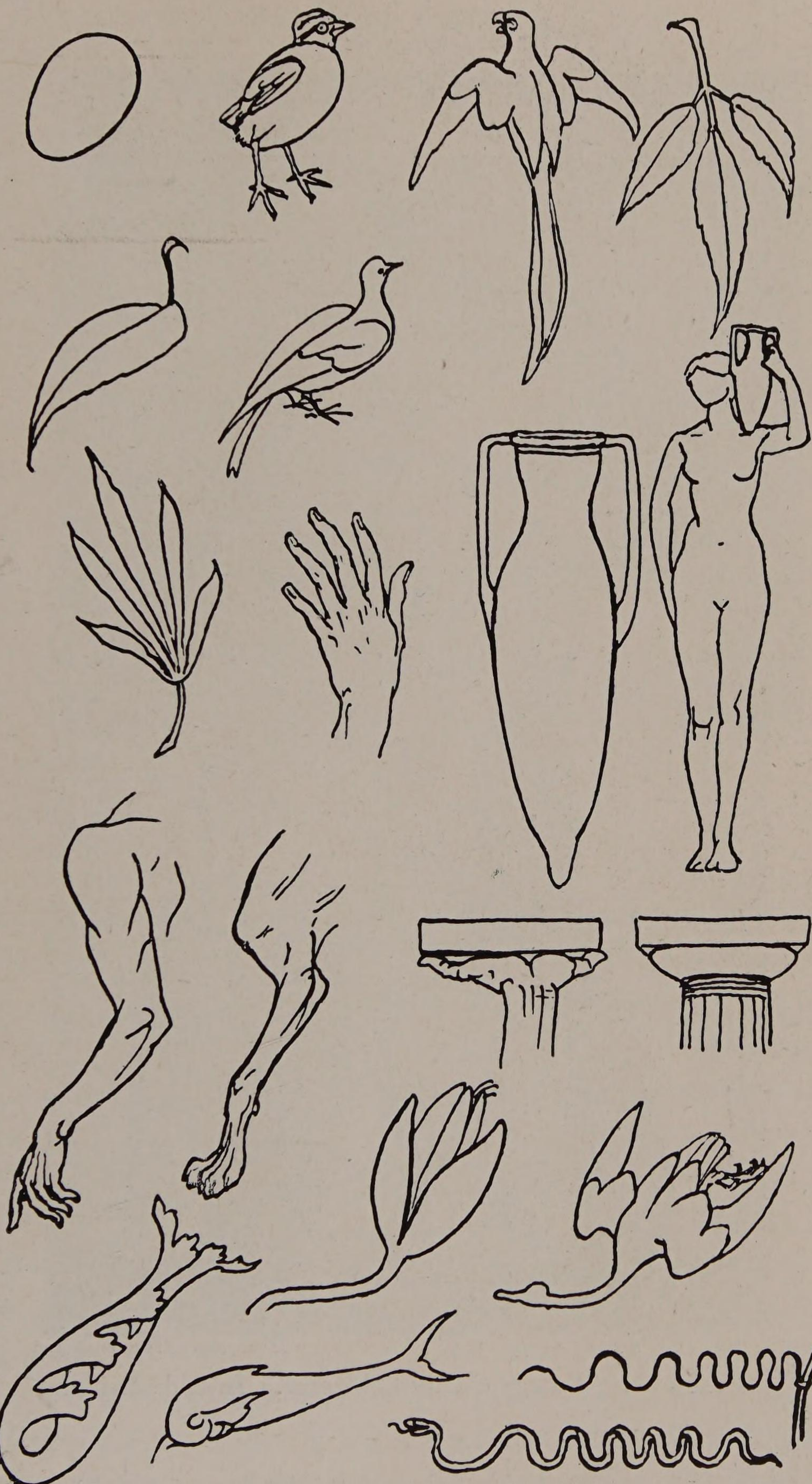
A poem in marble. Study her, analyze her, memorize her! Here is a true goddess—almost too beautiful to belong to this earth. A dream, perhaps, but a dream based upon nature's laws.

Possibly the feeling among many of our contemporary sculptors is that such perfection of beauty having been so superbly wrought by Greek sculptors, there is really nothing more to be said on the subject. Certainly the neoclassic artist of the



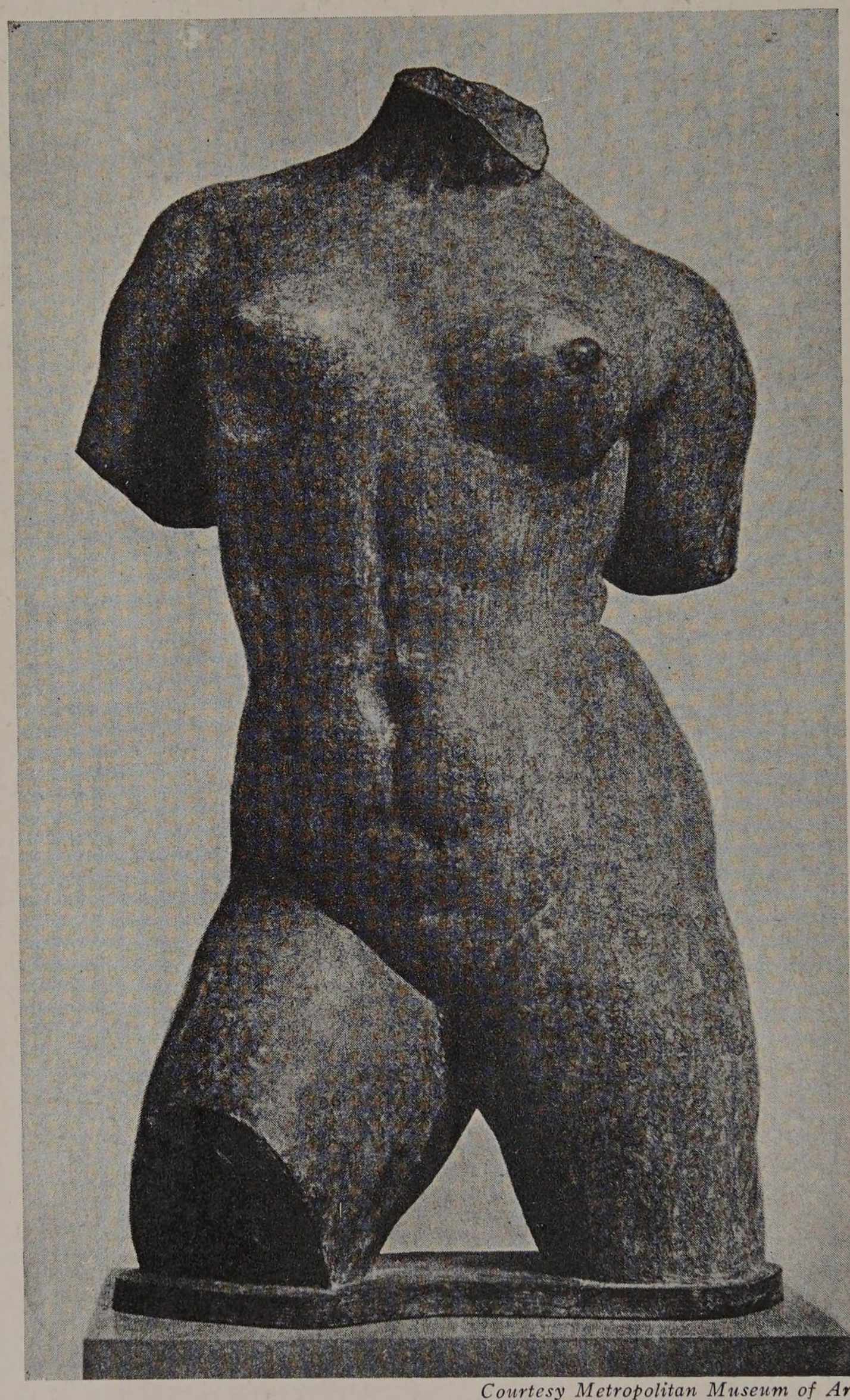
Courtesy Metropolitan Museum of Art

PLATE 86. "Venus of Cyrene," *Marble*



From "Line and Form," *courtesy George Bell & Sons, London*

PLATE 87. Analogies in Form. Walter Crane



Courtesy Metropolitan Museum of Art

PLATE 88. "Energy Chained," *Bronze*. Aristide Maillol

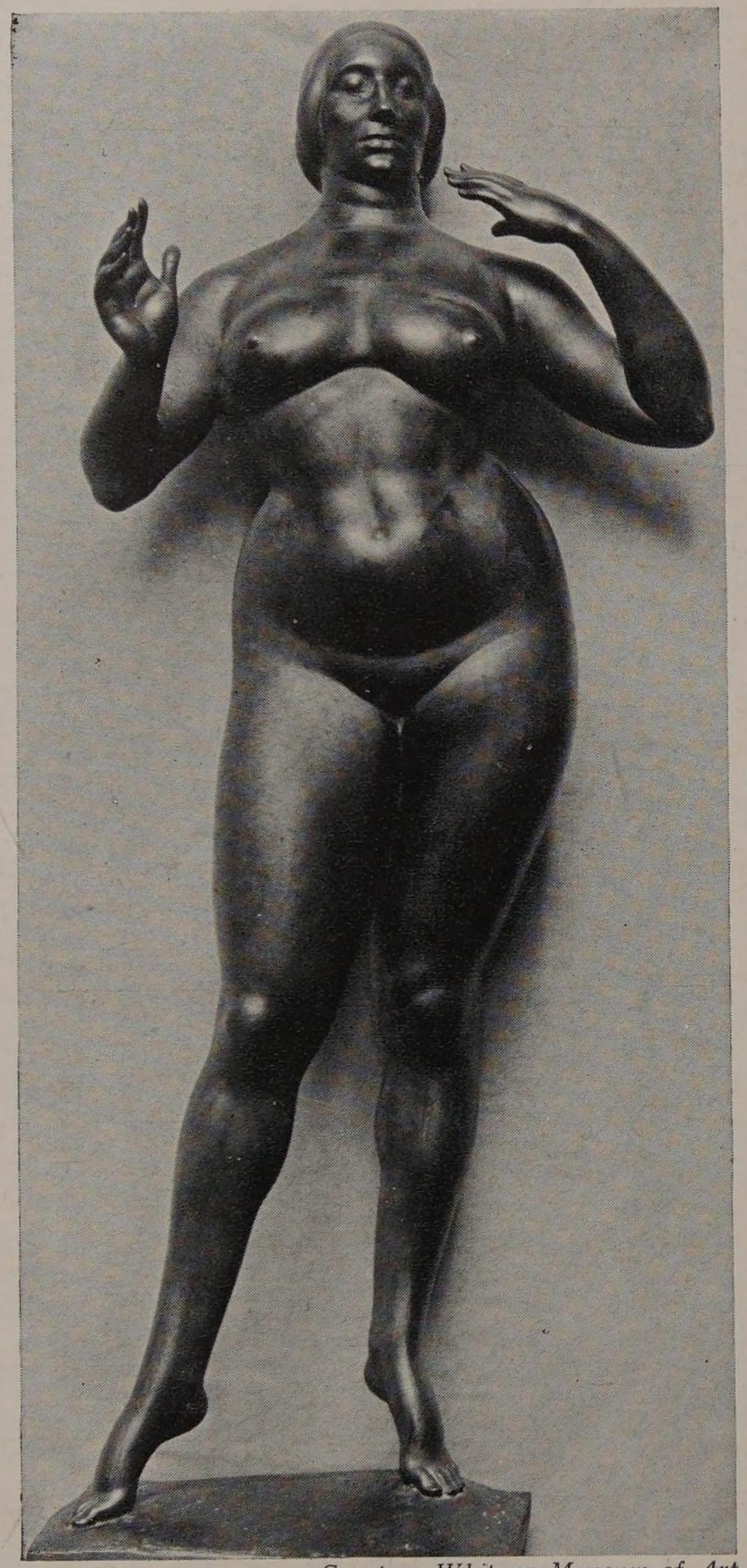


Courtesy Metropolitan Museum of Art

PLATE 89. "Seated Woman." Aristide Maillol

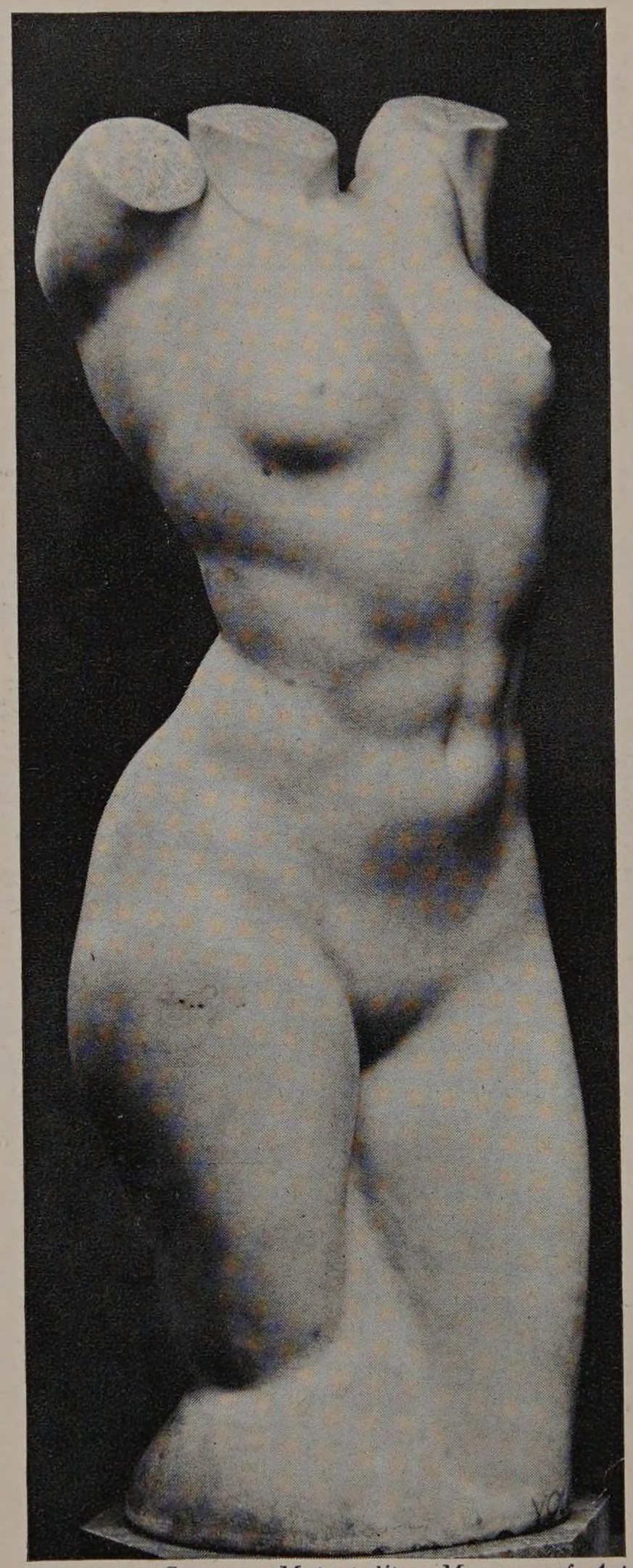
past century or so contributed practically nothing to art. And today the tendency is not to make goddesses, but to interpret the living women we see about us. The very solid and heavy female figure which is so prevalent in sculpture today, was practically never to be seen in the art of Europe or America until the beginning of the twentieth century. Many such figures are due to the revival of interest in direct stone carving. Stone does not *want* to be made slim. It seems to say, "I am a block. Leave me a block."

Both Maillol and Jane Poupelet have contributed much to our present-day appreciation of simplified and static interpretations of the female figure. Maillol's early "Seated Woman" (Plate 89), has become a modern classic, while the "Girl" of Mlle. Poupelet (Plate 93)—a small bronze in the Brooklyn Museum—has a monumental and almost Egyptian dignity that transcends all limitations of actual scale. In the Metropolitan Museum there is a characteristic example of Maillol's work—the heroic female torso (Plate 88). Critics have been quite unanimous in their praise of this vigorous conception and, so far as I know, no one has remarked what seems to me a very fundamental mistake in the torso—that rigid median line which runs down the abdomen. At the back, the sculptor has curved the corresponding line of the spine,



Courtesy Whitney Museum of Art

PLATE 90. "Woman," *Bronze.*
Gaston Lachaise



Courtesy Metropolitan Museum of Art

PLATE 91. "Volupté," *Marble.*
Arthur Lee

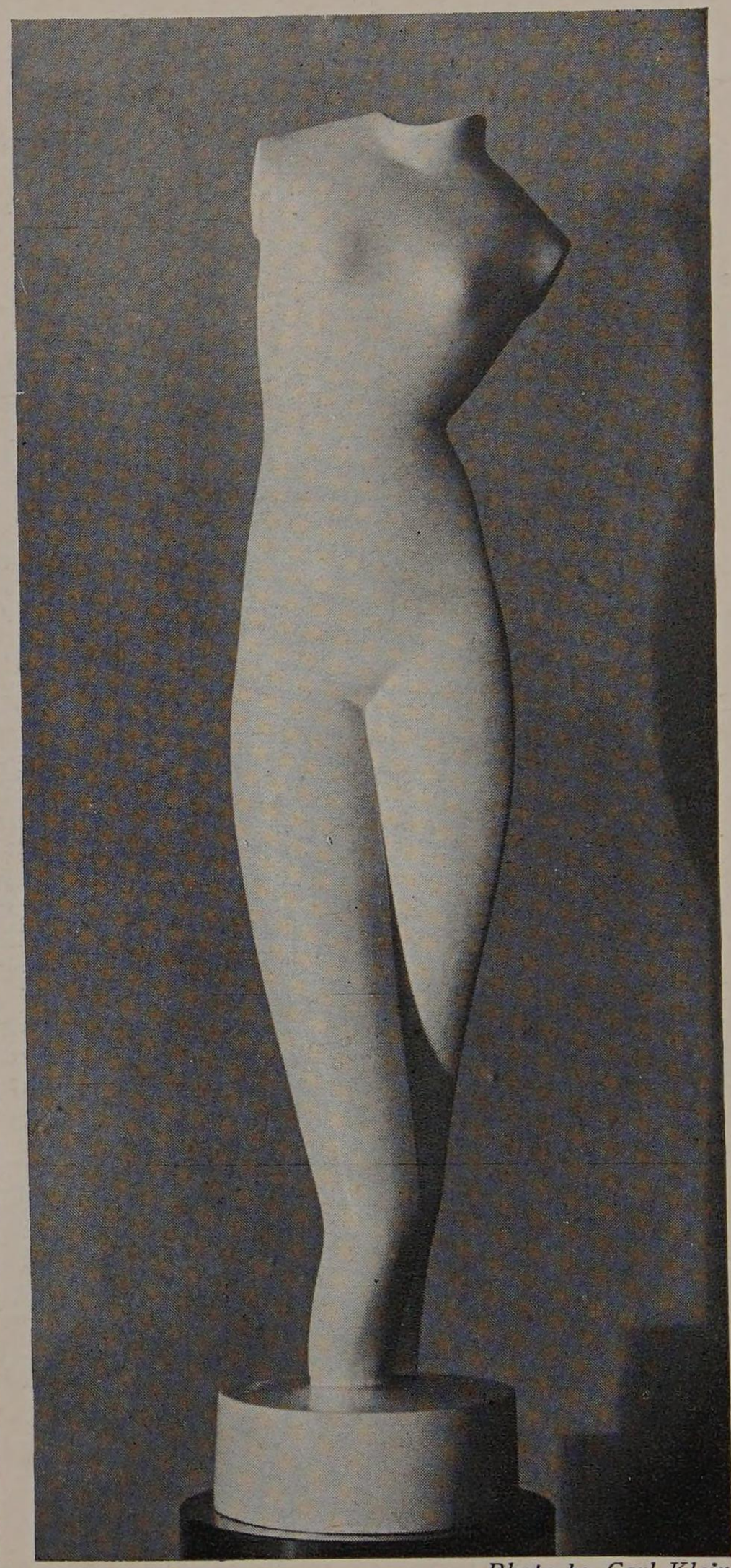


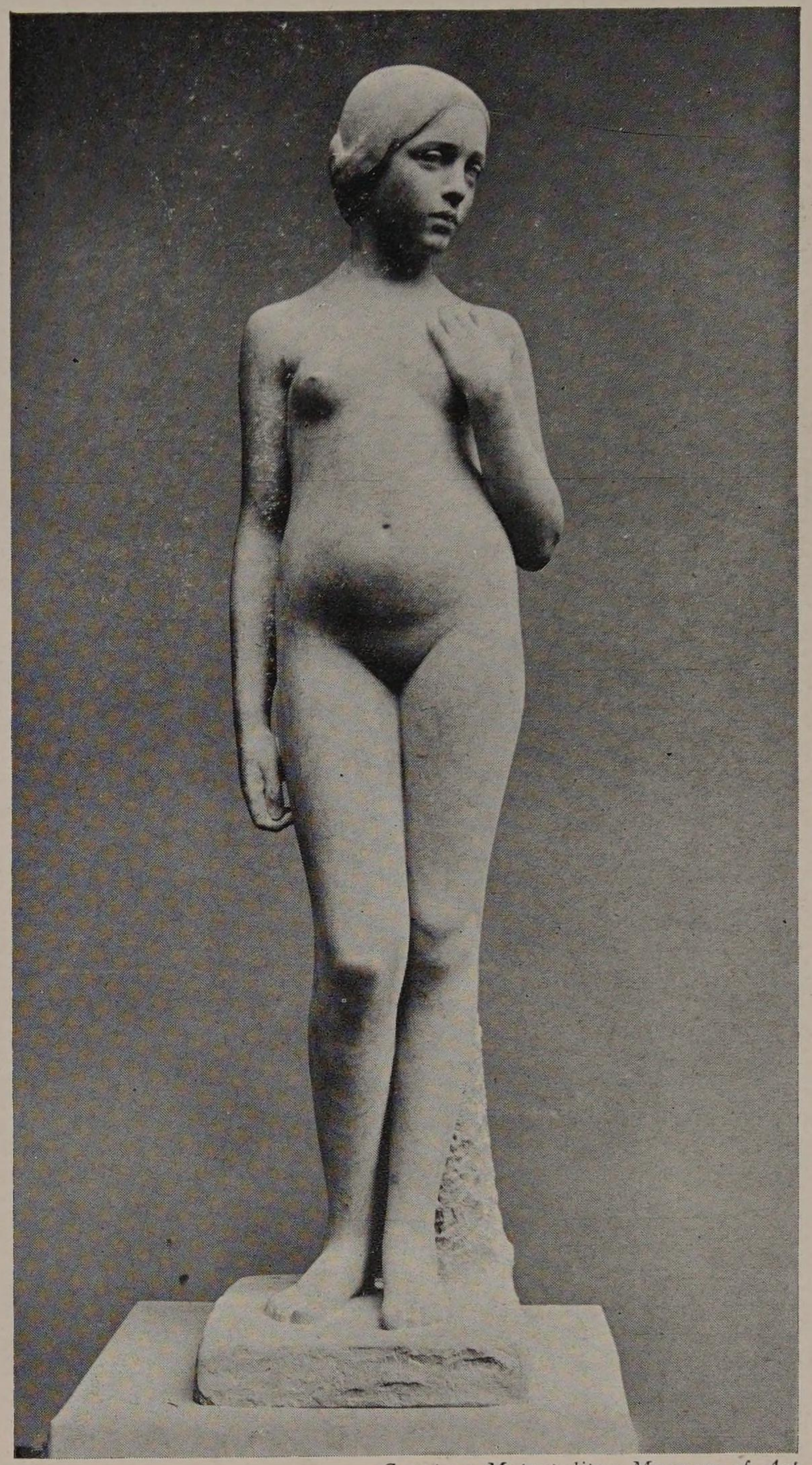
Photo by Carl Klein

PLATE 92. "White Torso," *Plaster*
Alexander Archipenko



Courtesy Brooklyn Museum

PLATE 93. "Seated Girl," *Bronze*. Jane Poupelet



Courtesy Metropolitan Museum of Art

PLATE 94. "On the Threshold," *Stone*. Edith Woodman Burroughs

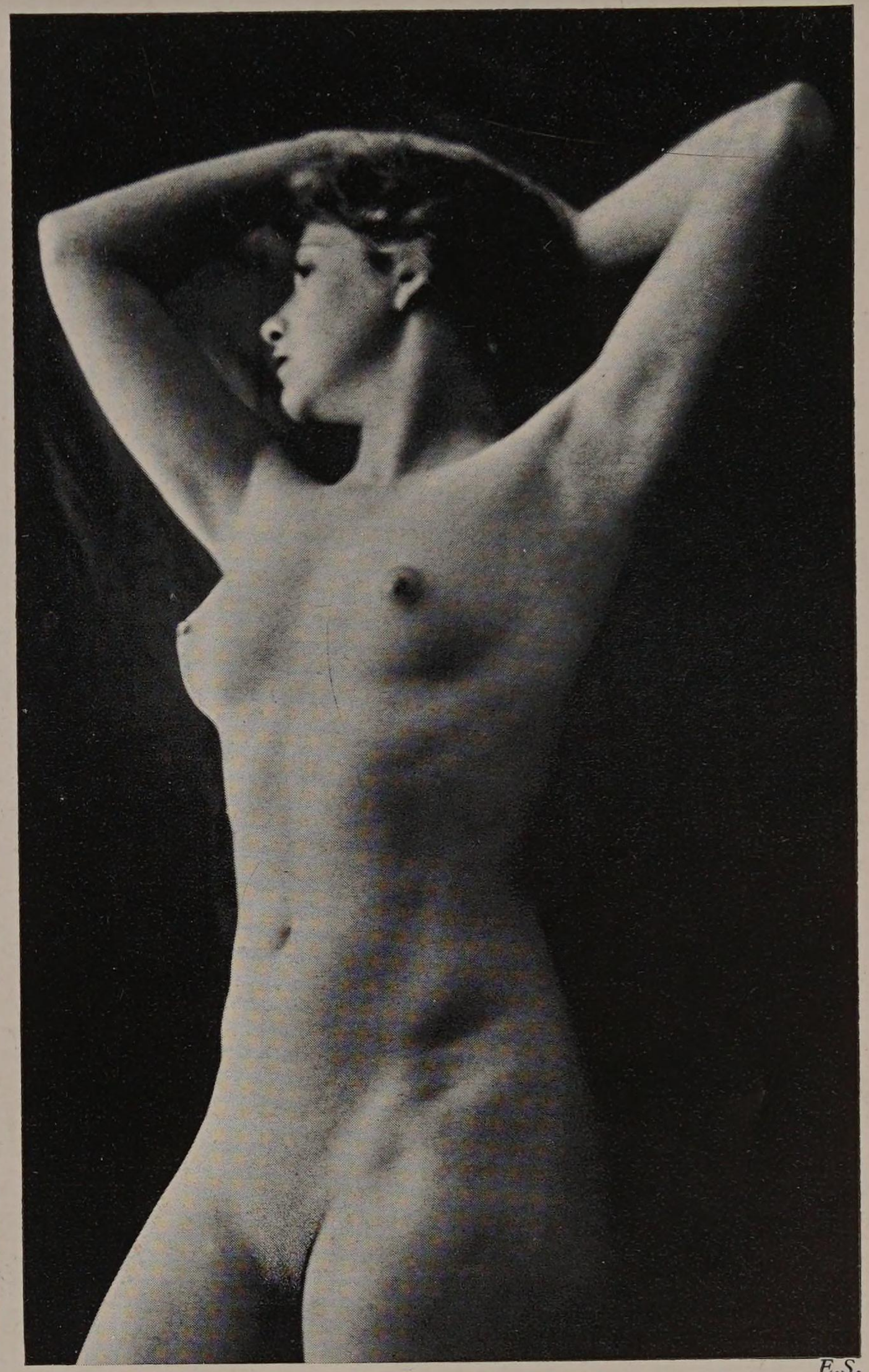


PLATE 95. "Reclining Woman," *Marble*. Ivan Meštrović



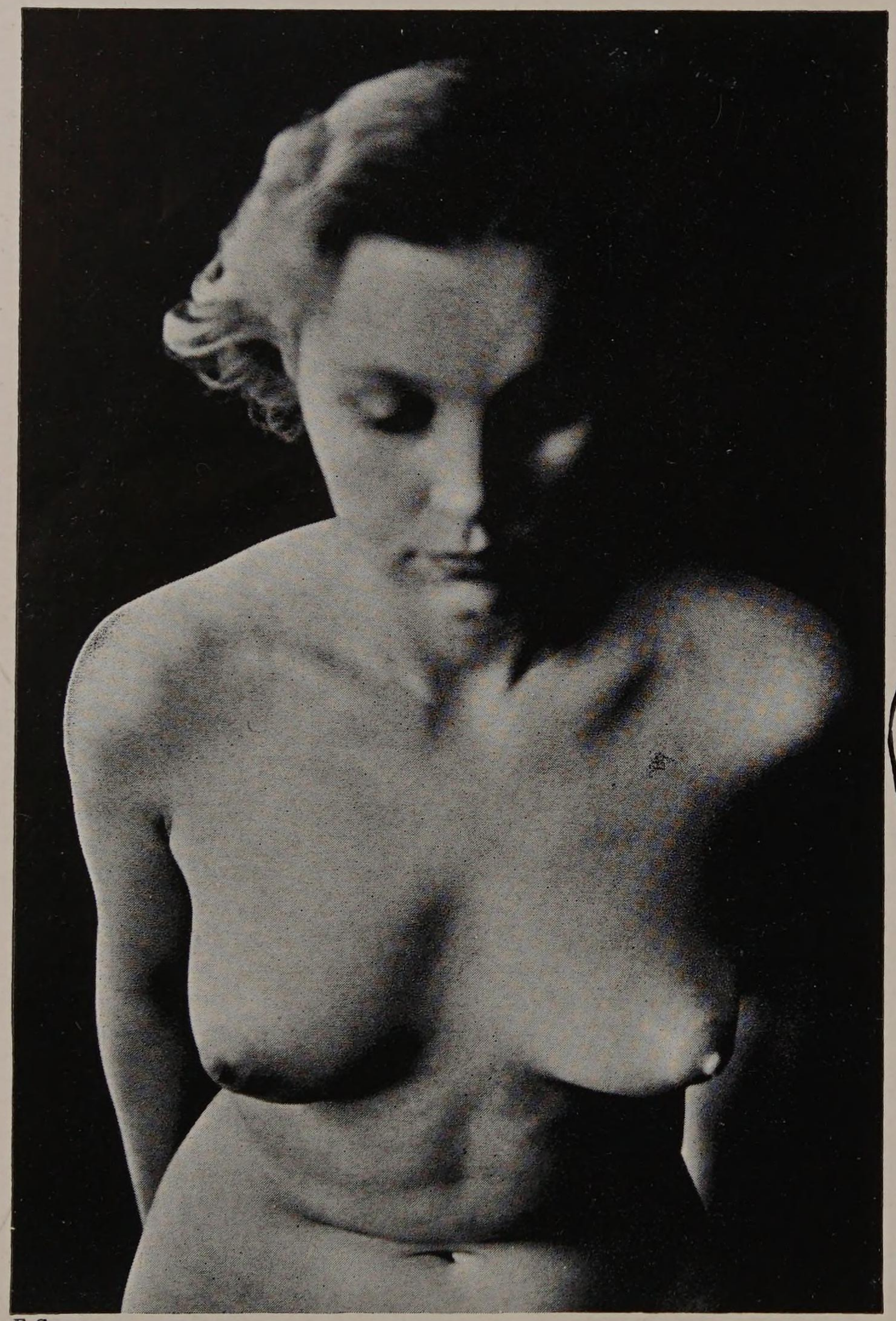
E.S.

PLATE 96. Torso of Woman, *Arms Down*



E.S.

PLATE 97. Torso of Woman, *Arms Raised*



E.S.

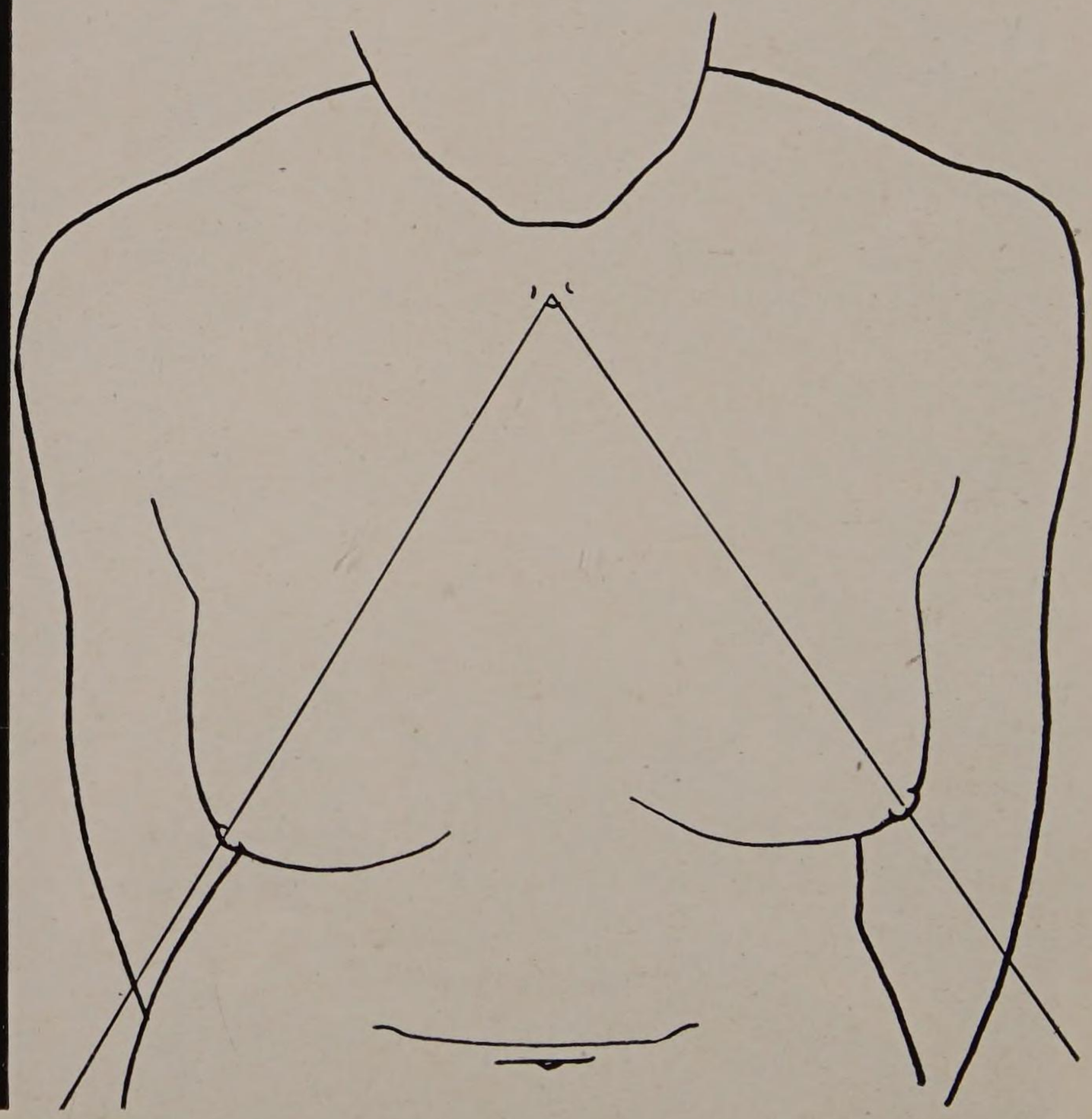


PLATE 98. Woman's Breasts from Above

bending it as it must bend with the hips thrust in one direction and the shoulders in another. Why, then, does he not curve that vital linea alba also? Surely a straight line here stops the action, while a sweeping curve would enhance the effect of strenuous movement which the sculptor is endeavoring to portray.

Perhaps no one today can handle a torso better than Arthur Lee, whose "Volupté" (Plate 91) is a superb example of the artist's skill. Before Gaston Lachaise became totally obsessed with a morbid absorption in heavy bosoms and buttocks, he made more than one distinctive and refreshing contribution to contemporary art. Plate 90 shows his voluptuous "Woman," with the deep, wide chest of an opera singer, heavy in build through the torso, yet marvelously balanced and poised on tapering legs that evoke the much-abused expression "elegant." There is a patrician air about this richly modelled figure which prevents it from being coarsely unpleasant.

Slim bodies, too, have their place in sculpture, as in the lilylike "White Torso" of that inventive and daring innovator, Alexander Archipenko (Plate 92). There is, to be sure, nothing very radical about this lovely, simplified creation, but I believe Archipenko was the very first to discover that significant forms might be made quite startlingly significant by turning them *inside out*. That is, he has made several figures in which thighs and breasts, for instance, are concave instead of convex!

A sculptor of whom America may well be proud, though an untimely death cut short her career, was Edith Woodman Burroughs. Living as she did in a conservative period of American art, Mrs. Burroughs was far ahead of her time in her broad and deliberately simplified handling of form. Her sincere and unself-conscious young girl (Plate 94) is fortunately preserved at the Metropolitan Museum.

But for truly epic grandeur, combined with sensitive yet powerful modelling, nothing can surpass the great marble women of Ivan Meštrović, one of which is shown in Plate 95. Without question, Meštrović is one of the most versatile, as well as the most thoughtful and imaginative sculptors of our day. Compare this plate with the stark simplicity of the archers (Plate 29, Chapter III), designed for and carried out in wood; and the patterned muscles and feathers of his dynamic "American Indian" (Plate 191, Chapter XV), designed for bronze. Here is a sculptor who truly thinks his work in its final medium.

Now that we have seen what some master sculptors have done with the female form, let us turn to a few photographs of living models. The model in Plates 96, 97, and 99 has a particularly beautiful torso for modelling. Though young, she is rich

in form, yet slim enough to have grace of line as well. Notice in the transition from Plate 96 to Plate 97, how the breasts follow the contour of the expanded thorax and actually point *upward* when the arms are raised.

An understanding of the form and direction of the breasts is almost universally lacking in the young student. He is prone to think of the breasts as lying parallel on a flat surface, and pointing directly forward. A glance at Plate 98 shows us how false is this notion. The breasts point *outward,* away from each other; and lines drawn through the center of each, meet at the pit of the neck. And a view from underneath would

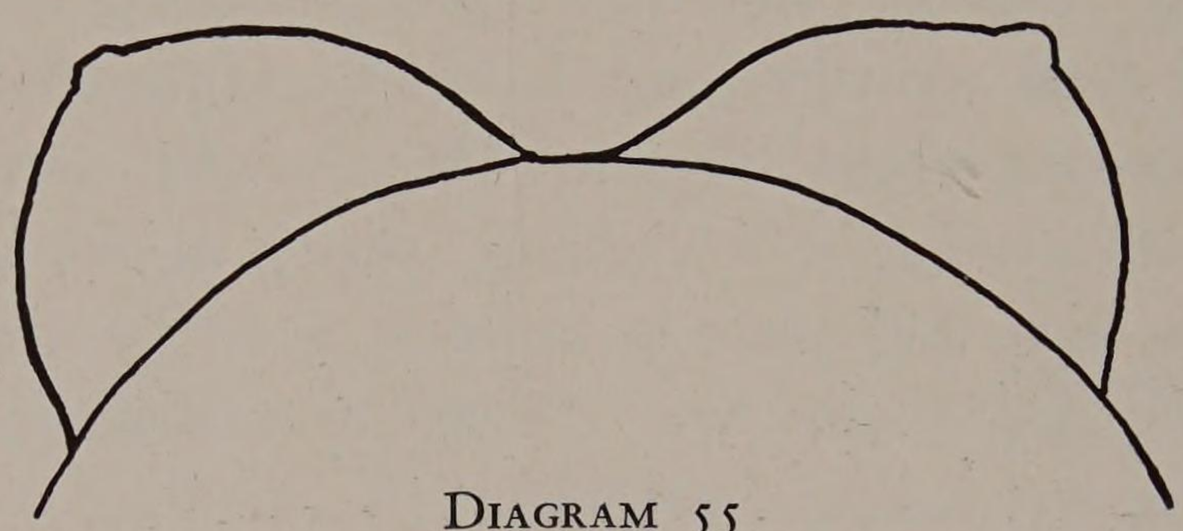
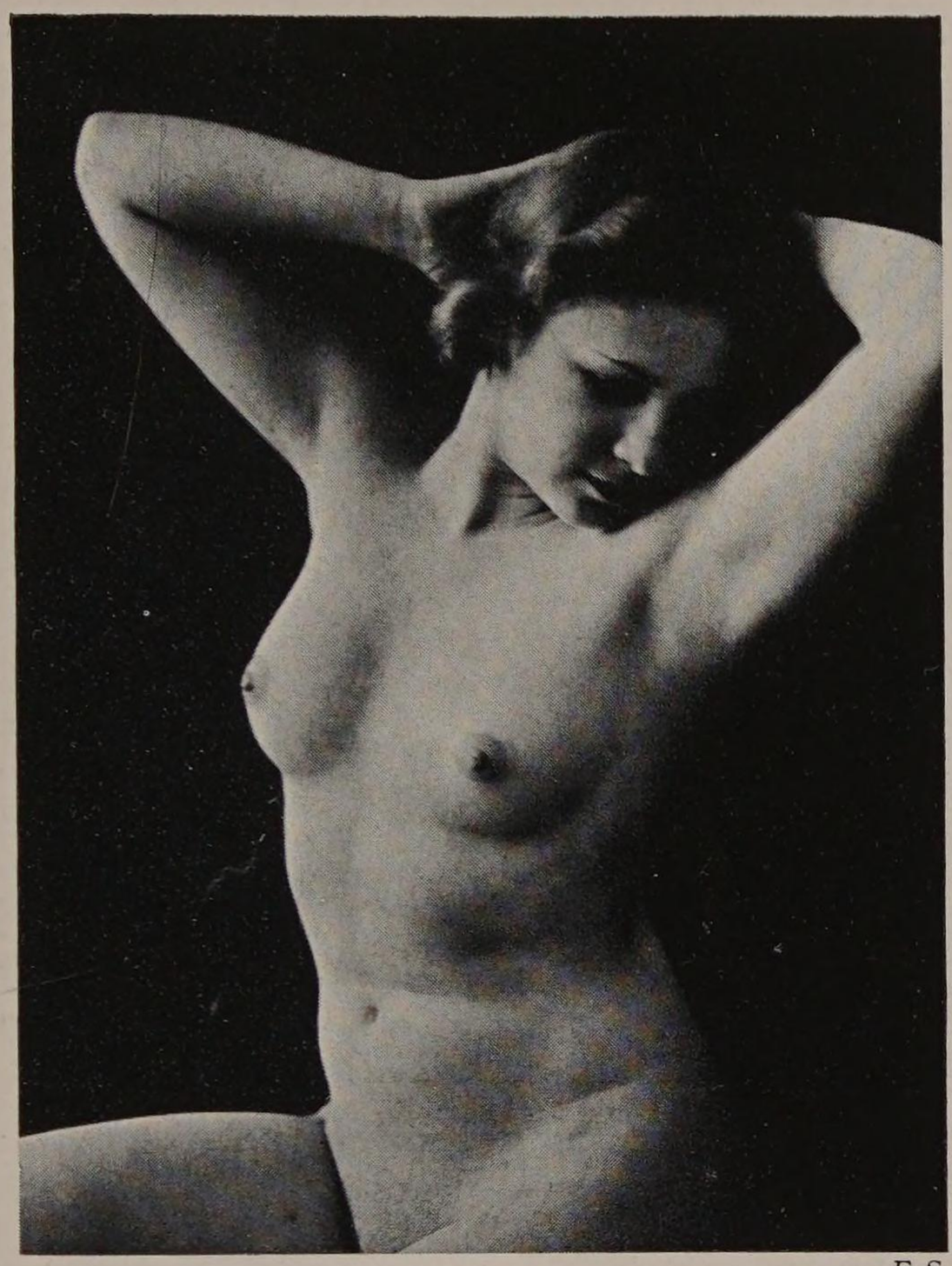


DIAGRAM 55

look like Diagram 55. Again, in a strong and healthy young person, there is almost as much fullness above the nipple as there is below it. Concavity above suggests old and sagging breasts, and a too-marked crease in the skin below them has the same effect. When working from a woman model for the first time, the student is apt to forget that her thorax is rounded, and when he sees a shadow between the breasts, he digs way into the sternum. That mistake once made, he is the more readily inclined to bring the breasts too close together, with the nipples pointing forward. He forgets, too, that under the breasts lie pectoral muscles, and that when one arm is raised both the muscle and the breast *must* lift with it.

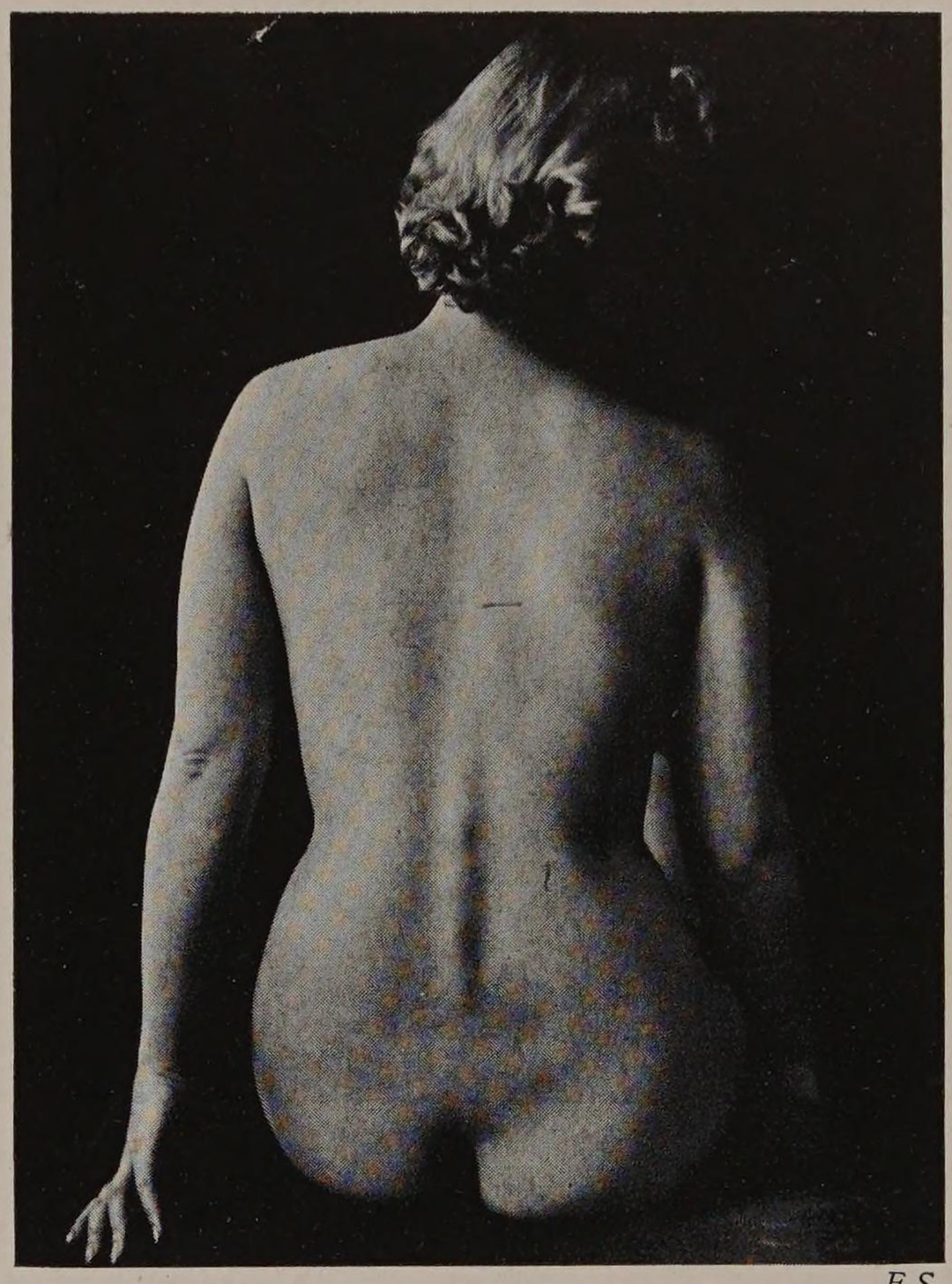
Though the student never seems to mind digging deep holes in a poor lady's sternum, or above her clavicles, or under her breasts, thereby making her look twice her age, he usually balks at making any depression whatsoever at the navel, content to give this just a perfunctory little toolmark. Yet there is gloriously rich modelling at this point—study Plate 97 and look again at Arthur Lee's torso (Plate 91).

A woman's wide pelvis inevitably gives her a slightly knock-kneed look, as compared with a man, but you should never unduly accentuate this characteristic by making too small a waist, or by making the thighs "shelve in" from trochanter to knee. In some models who are no longer very young, the effect is increased by an accumulation



E.S.

PLATE 99. Seated Woman, *Arms Raised*



E.S.

PLATE 100. Seated Woman, *Rear View*

of fat on the outside of the thigh just below the trochanter. This, unfortunately, tends to make the thigh, and therefore the whole lower limb, look shorter than it really is, giving a poor proportion to the whole figure. And when such a model is given a pose in which all the weight is resting on one leg, there is a further ugliness of outline in the flatness of the tensed muscles of the thigh which, under the overhanging weight above, look unpleasantly concave. Plates 101 and 102 show the lower limbs of a well-proportioned model.

It is an undoubted fact that many centuries of wearing high heels, and of exercising too little, have tended to shorten women's legs. Except in fashion-plate drawings (which still cling to an almost unattainable ideal), very few can boast such beautiful length of limb as the Venus of Cyrene possesses. Not only are her legs straight and long, but her ankles, too, are strong, fully able to support the weight above. Slender ankles may be pretty in evening gowns, but they look far too frail in a sculptured figure. Probably the surest way to correct such a tendency, if you feel it has a hold

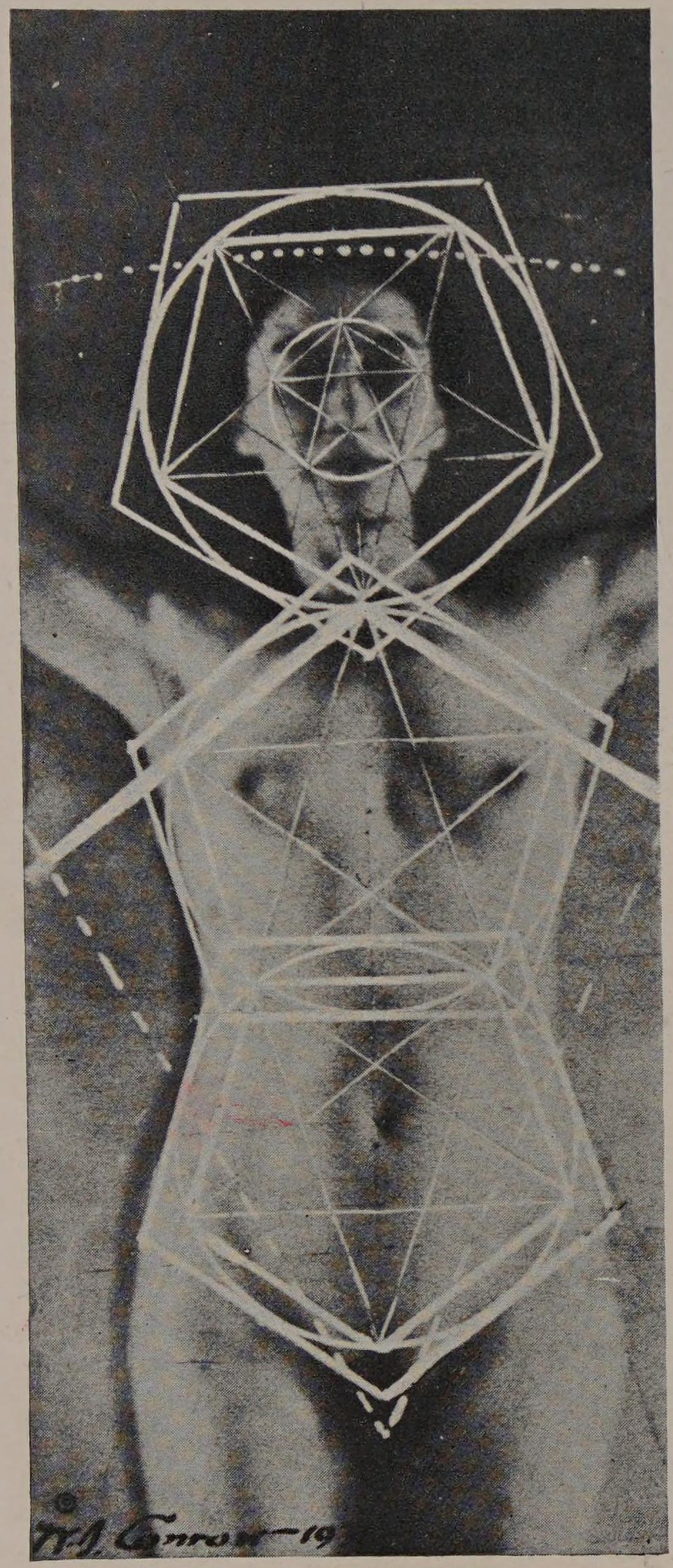


E.S.

PLATE 101. Woman's Legs, *Rear View*



PLATE 102. Adolescent Boy, *Rear View*



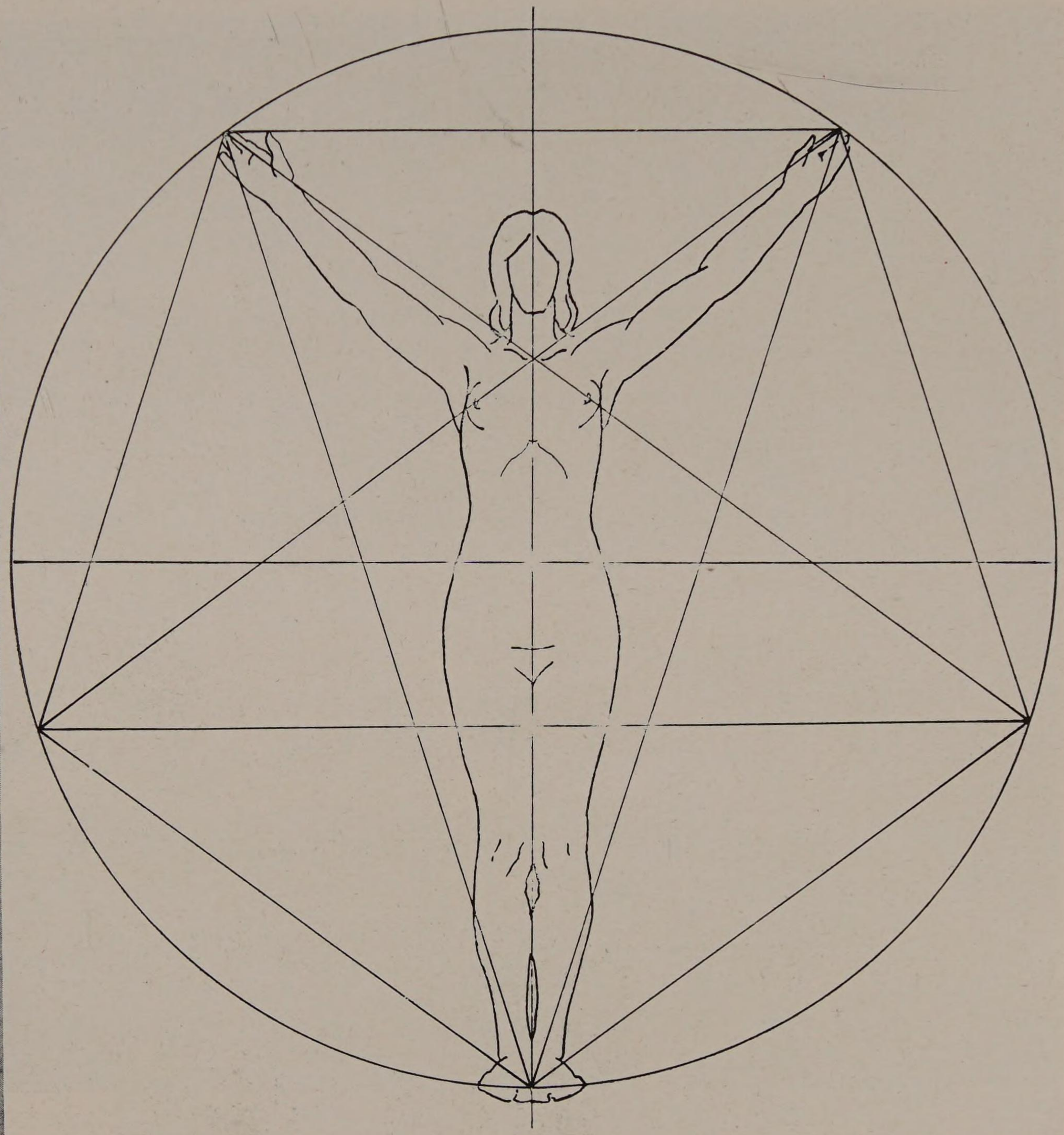


Diagram 56. Pentagon Pose, Wilford S. Conrow



PLATE 103. The Child in the Vineyard, *Stone*. Brenda Putnam



PLATE 104. Midsummer, *Marble*, by Brenda Putnam

on you, is to carve a figure in stone. The very material itself would call "Stop!" before you had chipped off too much.

To those who *instinctively* feel that the perfect proportions of the female body must be founded on some rational law of *mathematics* (as is *music*), I strongly advise a study of the findings of the artist, Wilford S. Conrow and his collaborator Dr. William Churchill. Between them they have evolved a convincingly logical method of determining the ratios of perfect proportion.

Such investigations are by no means new. Plato and Euclid delved deep into the subject, and Leonardo da Vinci was profoundly convinced that only through mathematics can the laws of perfect symmetry be found.

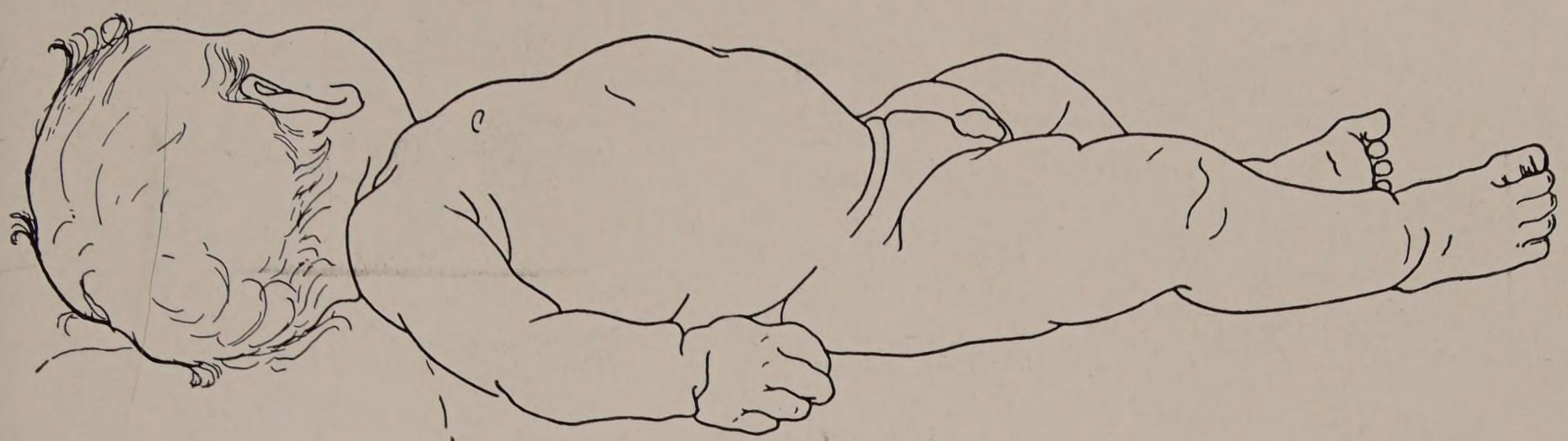
One of the most significant of Mr. Conrow's discoveries seems to me to be the "Pentagon Pose" (Plate 103), my simplified rendering of which may be seen in Diagram 56. In this, the navel forms the center of a circle upon which the pentagon is drawn. The fingers touch two corners of it and the feet rest upon a third.

To those of you who scoff at any attempt to confine beauty within geometric boundaries, let me quote the first line of an inspired sonnet by Edna St. Vincent Millay, in "The Harp Weaver":

"Euclid alone has looked on Beauty bare"

CHILDREN

From two or three to seven, the child usually goes through a slimming process, with lengthening of limb and of neck, which, however, is still very slender compared to an adult's. The greatest length of neck is at the back, giving, in profile, a marked appearance of "riding up" to the large skull. The abdomen flattens, the creases at wrists and ankles disappear. After seven or eight, the feet and hands grow rapidly, and the bony structure at shoulders, elbows and knees becomes marked. Self-consciousness makes its appearance, and it is difficult indeed to find youngsters of nine to fifteen who are willing to pose in the nude. In Mrs. Burroughs' figure of a girl about fourteen (Plate 94), and in the photograph on page 184, we have typical examples of children in their teens.



BABIES

Search as you may through all the early art periods, Egyptian, Greek, Roman and many others, you will never find a single statue or painting of a true infant. Stiff and stylized "little men" you will find aplenty; naturally, the Egyptians stylized their children as they did their men and women. One would not expect anything else, nor would they look right any other way. And in the early days of Christianity, the Church would have frowned on any literal depiction of the Christ child. But with the Renaissance, all such taboos were swept away and the painters and sculptors were free to depict their own wives and children as Madonnas, saints and cherubs, if they so chose.

Yet even then, possibly because the artists were all men and being men had a natural distaste for the *very* newborn infant, we find not a single picture or sculpture of the Nativity, among all the thousands that were made, that shows a convincingly newborn babe. They are anywhere from six to nine months old, before any artist deems them worthy, apparently, of his brush or clay.

Perhaps this is a field in which women artists might outshine their masculine confrères; for I truly believe they see qualities in very young creatures which are altogether lost to the male artist. And by this I do not mean a merely sentimental and maternal rapture over any helpless babe. I mean a genuine, discriminating appreciation of what they see and an ability to translate that appreciation into art.

Possibly it is because they are so taken aback at their first glimpse of a newborn child, that most men tend to make their clay children the very opposite of what they have seen. But while an infant Hercules may be appropriate in some heroic group of classic mold, such overdeveloped bodies, with square pectoral muscles, "patterned" abdomens, and bulgy calves, are absurdly false and unconvincing when applied to









more intimate sculpture. *No* living child possesses these things. Its body is far more elusive and subtle. Stereotyped anatomical formulae will be of little use in analyzing it.

As a sculptor who has made innumerable attempts to capture the peculiar charm of babies, I can sympathize profoundly with those who have also tried. Baby models are extremely scarce and one can seldom have one rolling nude about the studio, as one would a kitten or a puppy. Moreover, one cannot command them to take and hold a pose. One must simply watch and memorize everything one sees, later building on that memory. Photographs are one's greatest help when faced with such a problem and I advise every student to make a collection of "scraps" from newspapers, magazines, etc., to which he can constantly refer.

Besides the sculptors who make "little men" instead of babies, there are others who err along other lines. They have an idea that if they just give their clay infant a bulgy forehead and a distended tummy, they have done enough. But it isn't nearly enough, nor are these characteristics true of a child less than six months old. As a matter of fact, when a child is born its eyes are usually more prominent than its forehead, which is quite receding. As the child's first duty in life is to nurse, the muzzle, with its projecting upper lip, is its most prominent feature.

Newborn babies are almost never fat. Indeed, even in the healthiest, arms and legs are pathetically thin and weak. The back, which does not develop any lumbar curve until the child learns to stand upright, is curiously straight and flat, while the thorax is generally more prominent than the abdomen. Both hips and neck seem incredibly fragile. The young child's neck, indeed, is so small it is hardly noticeable—the head seems to rest directly on the narrow shoulders. This delicacy of neck persists until the child is several years old. Nearly everyone makes a baby's neck too thick and too long. Nearly everyone, too, models a child's foot with the toes tapering to a point, as though it had been shaped by a tight pointed shoe, whereas an infant's foot is widest at the ends of the toes, which are almost all the same length.

In modelling the baby's big tummy be very careful not to place it too low. A pendulous abdomen is horrid, either in a child or in a grown person, and will not be found in a healthy baby. Wrists and ankles are creased with fat and are large in comparison with the rest of the limbs, because the muscles are so undeveloped. And there are always lateral creases on the inside of the thigh until a child is two or three years old. Bony structure (acromion process, elbows, knees) is usually indicated by dimples.



Courtesy Metropolitan Museum of Art

PLATE 105. "Paulina," *Marble*. Paul Manship

I have asked Marion Sanford to reproduce for you a few "notes" on babies, gleaned from my files and various sketchbooks. As drawings they have no value whatever, but as studies of children they may help to clarify this text and be of some assistance to you when you attempt your first children in clay.

Although I maintain that most sculptors have failed to catch the subtle loveliness of babyhood, I freely admit that there are a few who have done exquisite work in this line, as, for example, Paul Manship, in his masterly portrait of his daughter Paulina at the age of three weeks (Plate 106).

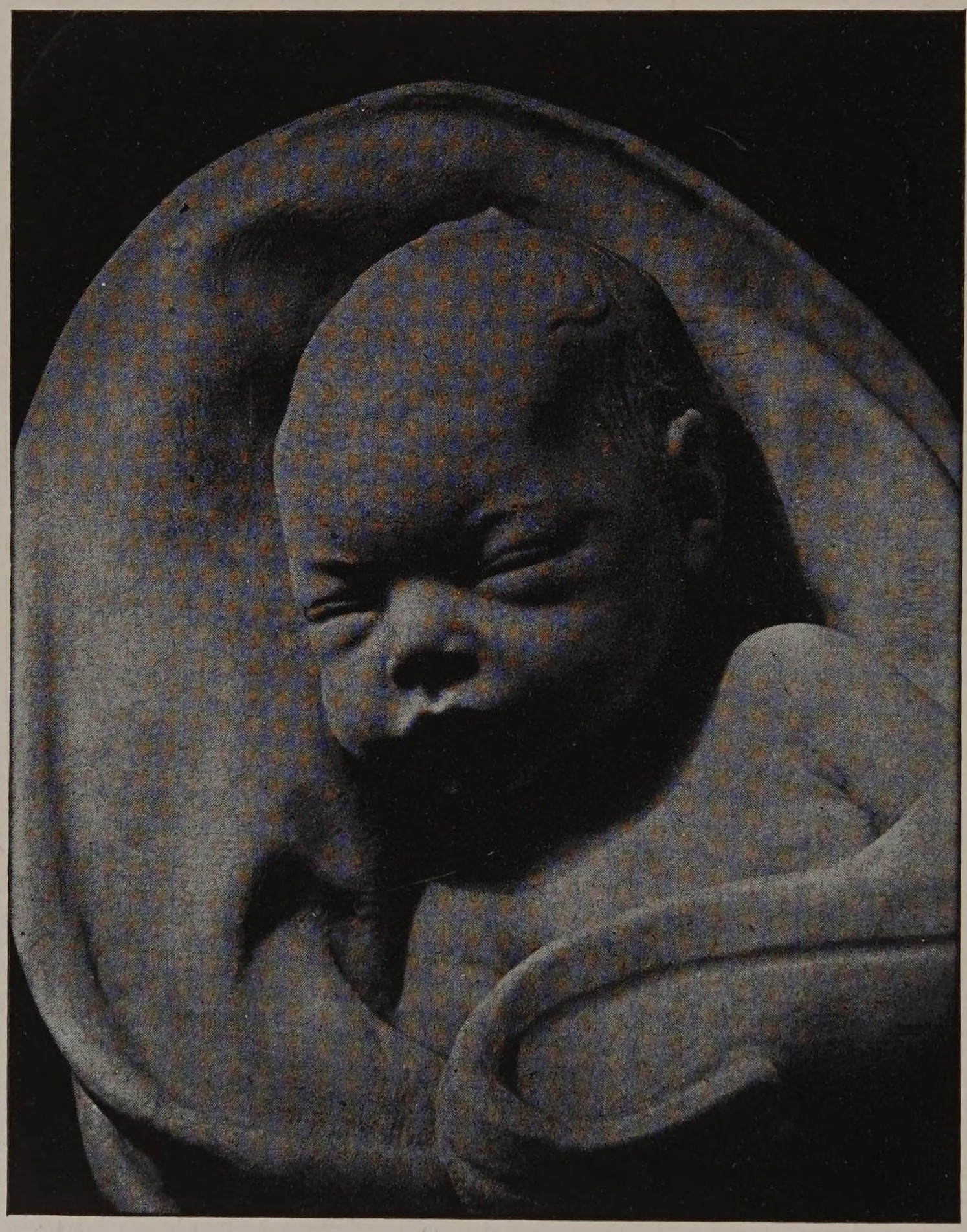


PLATE 107. Desmond, Three Days Old, *Marble*. By Brenda Putnam

CHAPTER VIII

COMPARATIVE ANATOMY

QUADRUPEDS

NEXT to the human figure, the animal is probably of greatest interest to the sculptor. Anna Hyatt Huntington, for instance, prefers to model animals almost exclusively. And with what keen discernment she expresses the character and action of each different creature! (Plate 108). A lifetime may well be spent in studying and portraying them. Even though you do not expect to specialize in animals, you must at least be able to approach the subject with some degree of understanding. Who knows when you may be called upon to submit a design for an equestrian statue, a coin or medal with an American eagle, or a portrait of some prize-winning dog or horse?

There are a number of good books on the anatomy of animals, which should be of assistance to you. In this chapter we can but glance at a few of the animals which are most frequently used in sculpture. But I believe that once you have mastered the principles of construction in birds and mammals, you will be able without difficulty to understand the underlying construction of any animal, be it elephant or mouse.

From our study of evolution we realize that all vertebrates have developed or ascended from the various prehistoric lizards. Therefore we know that fundamentally their skeletons must be the same. They must have skull, spine, thorax, shoulder and pelvic girdles, and two arms and two legs. It is not difficult to think of the lizard's forelimbs as arms. But when we consider such a familiar creature as the horse (Diagram 58), we are thrown off our guard by that old Latin term "quadruped"—*four-footed.* Erroneously thinking of his two front limbs as *legs,* we are still further led astray by the popular belief that their middle joints are *knees.* Everyone speaks of a horse as skinning its knees when it stumbles and falls. But let us analyze this diagram and determine just what these so-called knees are.

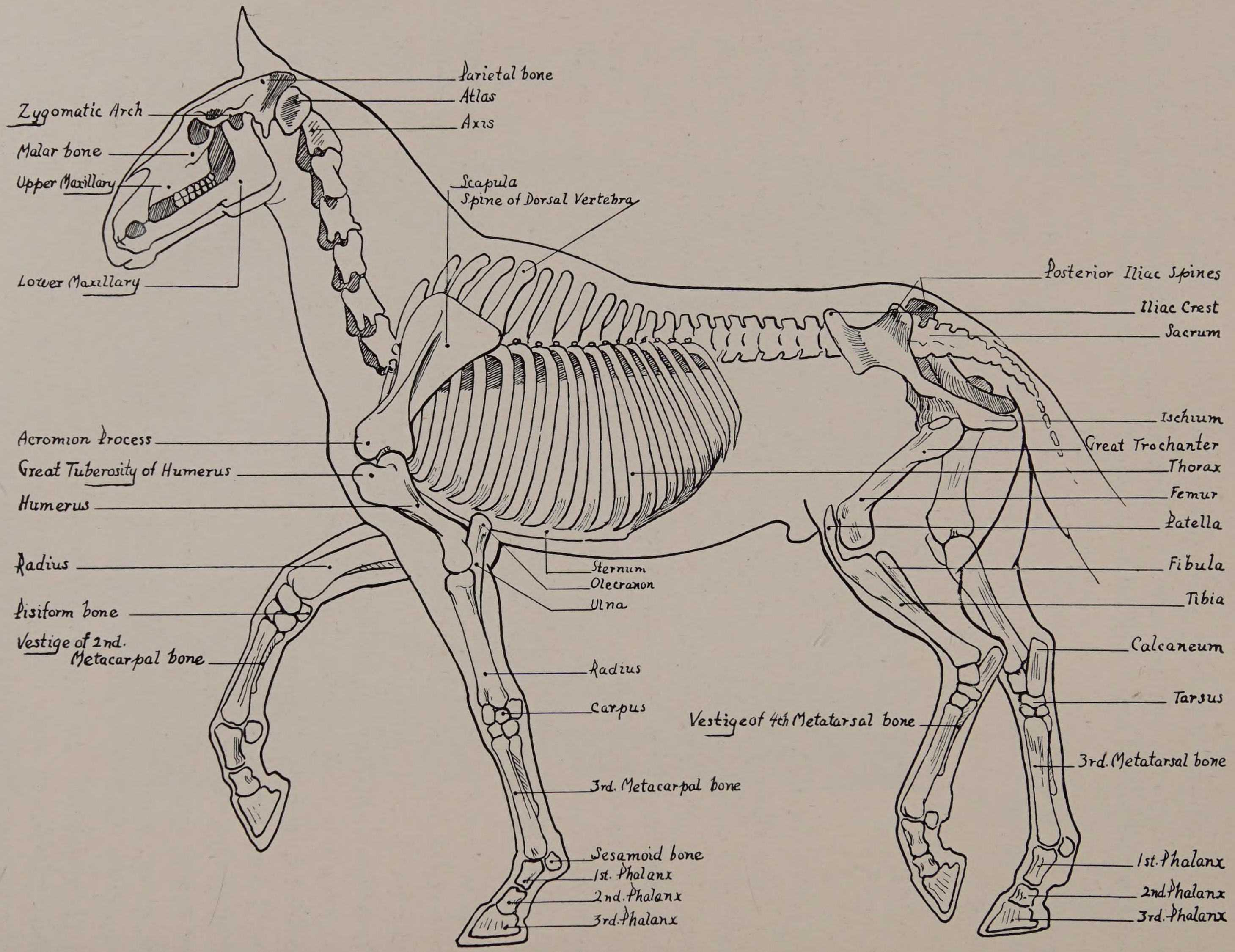

Parietal bone
Atlas
Axis
Zygomatic Arch
Malar bone
Upper Maxillary
Lower Maxillary
Scapula
Spine of Dorsal Vertebra
Posterior Iliac Spines
Iliac Crest
Sacrum
Ischium
Great Trochanter
Thorax
Femur
Patella
Fibula
Tibia
Calcaneum
Tarsus
Vestige of 4th Metatarsal bone
3rd. Metatarsal bone
1st. Phalanx
2nd. Phalanx
3rd. Phalanx
Acromion Process
Great Tuberosity of Humerus
Humerus
Radius
Pisiform bone
Vestige of 2nd. Metacarpal bone
Sternum
Olecranon
Ulna
Radius
Carpus
3rd. Metacarpal bone
Sesamoid bone
1st. Phalanx
2nd. Phalanx
3rd. Phalanx

DIAGRAM 58

Beginning at the head, we trace the neck down to the shoulder girdle. Shoulder it obviously is—even the most ignorant stableboy will agree to that. The scapula is plain to see, very like our own, except that it points in a different direction. Inserted in the socket of the scapula must most certainly be the humerus, short and thick, as it is in most quadrupeds. At the lower end of this must certainly be the elbow, with the olecranon thrusting upward, close to the thorax. The ulna tapers away fairly abruptly, but the radius carries on down to what? The *wrist,* of course. The carpus, with its mosaic of small squarish bones. So now we know that it is his wrist which gets hurt when our horse falls down! (Note that the pisiform bone, so small in man, is much developed in quadrupeds and serves as a fulcrum for the flexor muscles.)

To understand the lower part of the horse's arm, we should know a little more about his evolution. Ages ago, the ancestor of the horse was a small creature about the size of a dog. Scientists call him Eohippus. He had already begun to dispense with some unnecessary toes and fingers, and had only three on each "foot." Eohippus was a mild and defenseless little creature, and his sole means of escape from enemies was flight. Being thus forever on tiptoe, ready to run to cover, he used his middle fingers and toes to the exclusion of the others, which gradually shrank and atrophied. Eventually, as he grew in stature and evolved into a horse, the nails of these now strong middle fingers and toes developed a large thick process which we call the *hoof.*

So below the carpus, we find the single third metacarpal bone bearing all the weight, with vestiges of second and fourth metacarpals clinging to either side. Behind the single "knuckle," we find a large sesamoid bone, known in horsy parlance as the "ergot." And the "hand" terminates, naturally, in a single finger—phalange, phalangine and phalangette.

Returning once more to the neck, notice that the cervical vertebrae sweep upward from the horizontal dorsals almost at a right angle. Powerful neck muscles, pulling from the long dorsal spinous processes to the large atlas and axis, fill this right angle and, when superbly developed, as in a Percheron draft horse, give a noble arch to the horse's neck. Those long spinous processes form what is known as the horse's withers.

The horse has no clavicles at all. His thorax has eighteen ribs on either side and, as in all quadrupeds, is far narrower from side to side, and deeper from front to back, than that of man, as will be seen in Diagram 59, showing the skeleton of a horse from above. The lumbar region of the spine normally has no curve what-

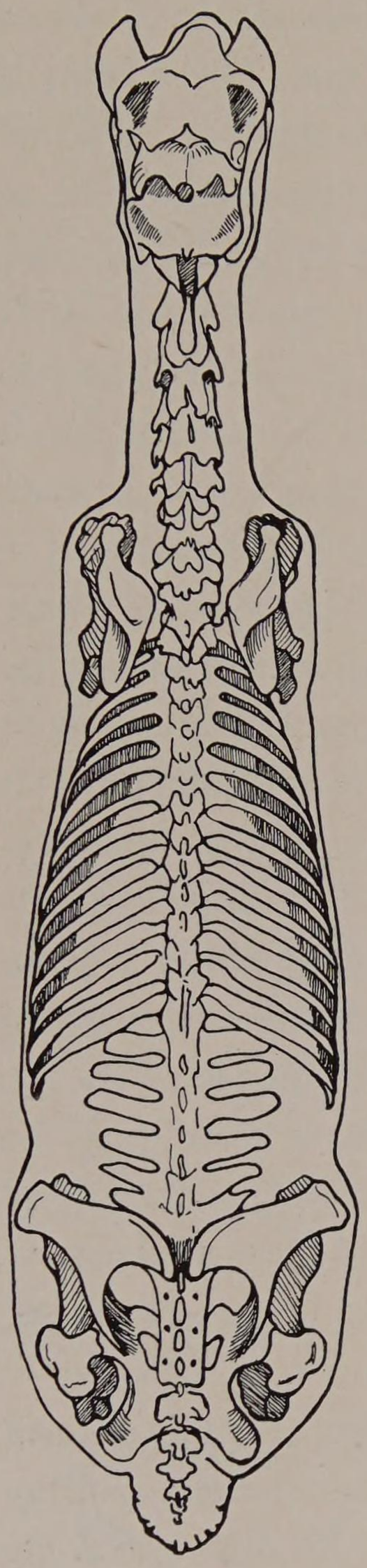


DIAGRAM 59

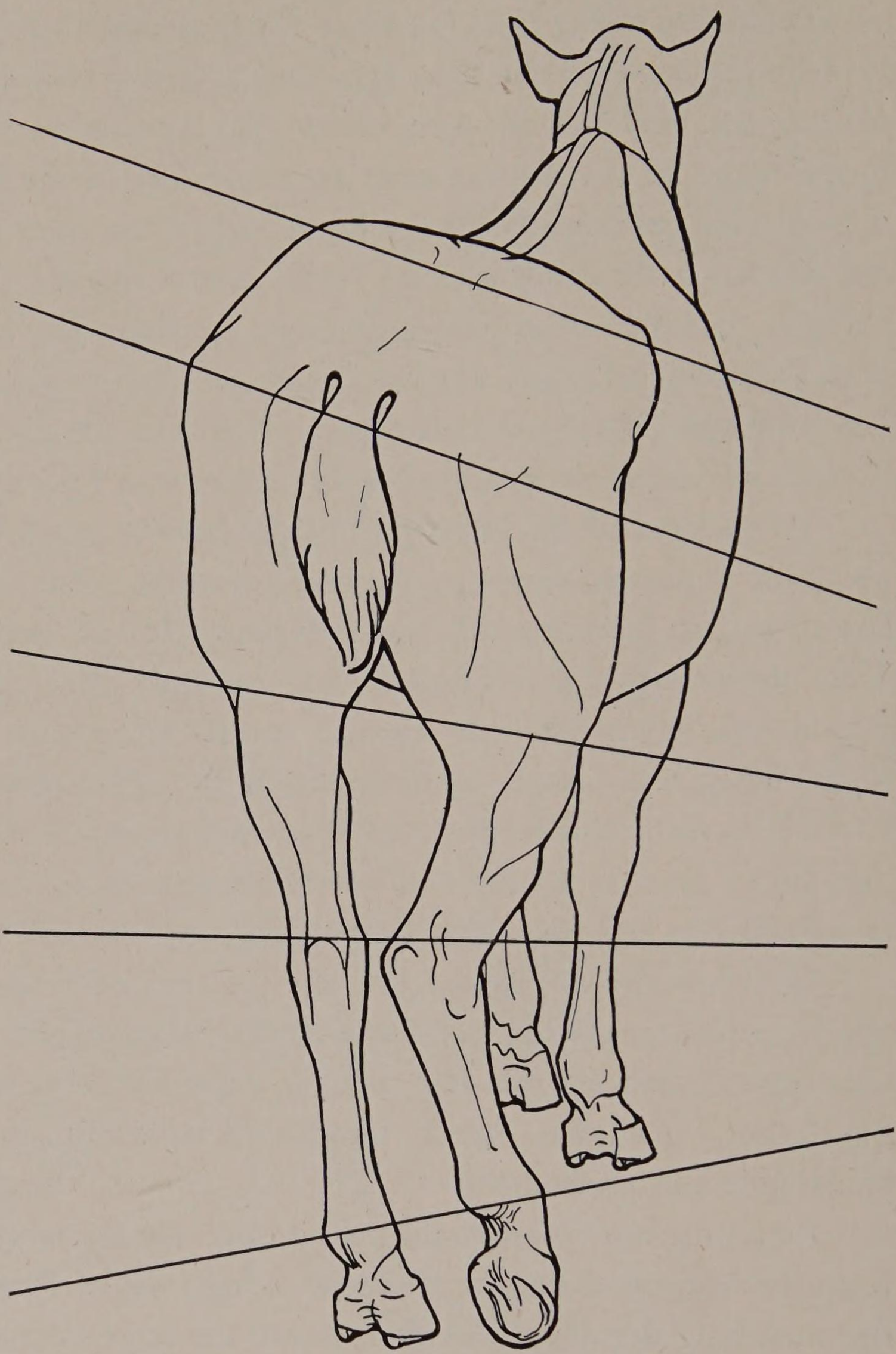


DIAGRAM 60

ever. Some sorry nags, it is true, become sway-backed through old age or overwork, but sway-back in a thoroughbred is unthinkable.

The projecting iliac crest is immensely important in all quadrupeds. Not being developed as a "containing basin," the pelvis is longer and more angular in form than ours. Nevertheless, the important structural points are much the same. The pelvis

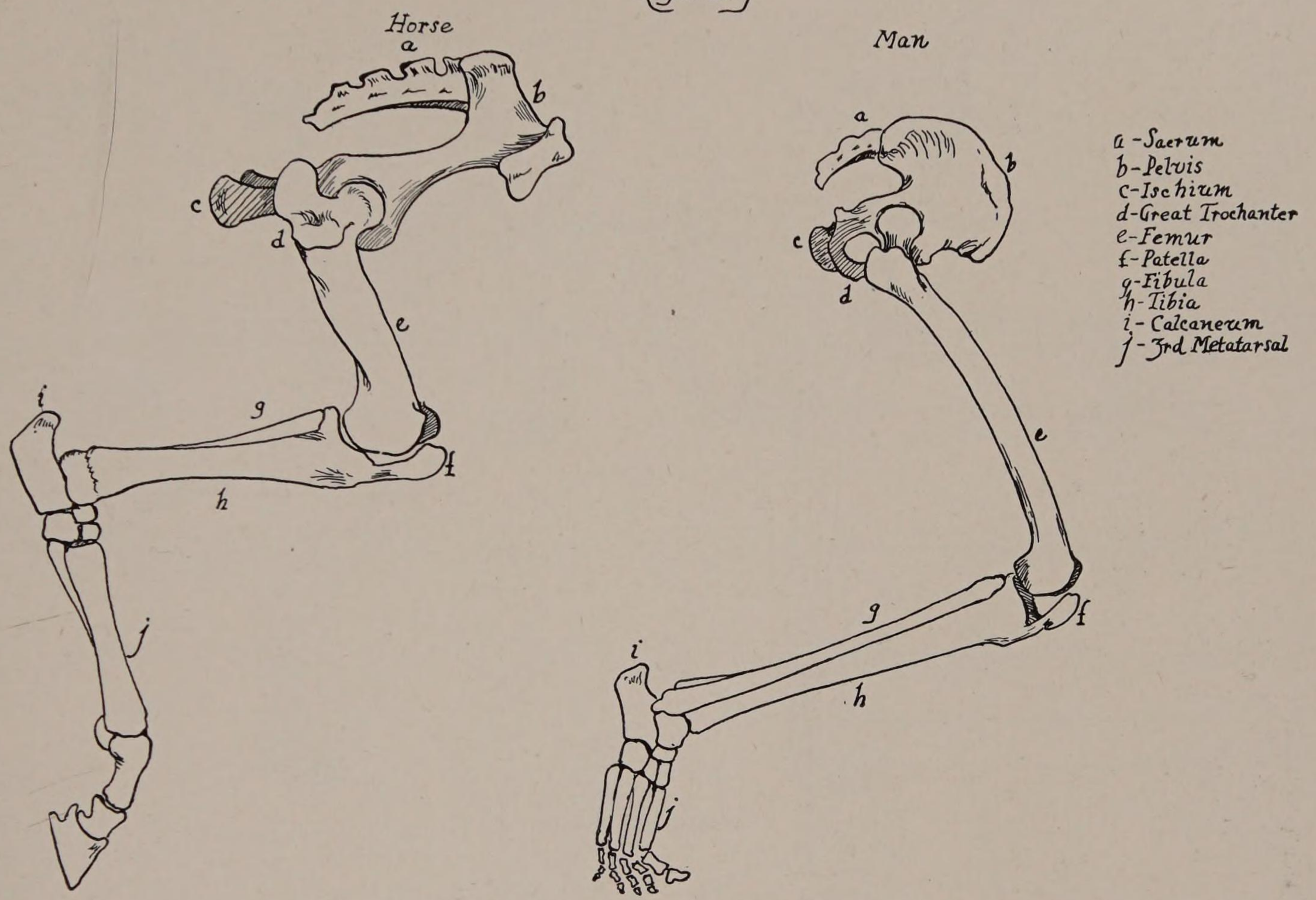


DIAGRAM 61

is tipped forward at such an angle that the two ischia project backward on either side of the root of the tail, while the short, thick femur again thrusts forward at an angle. Only in man can the femur be fully extended in a line with the direction of the pelvis. In every animal the hind leg is a succession of zigzags: back, from iliac crest to ischium; forward, from great trochanter to knee; back again, from knee to heel; forward again, from heel to toe. And what is the heel of a horse? Diagram 61 will explain. Of course it is his "hock"! And below that we find the same variations in the foot as we did in the hand.

Lack of space unfortunately forbids any diagrams or detailed descriptions of the muscles of animals. For the most part, they are very like our own, the major differences being in size and development. But one thing should at least be made clear, if we are to understand the rump of an animal (Diagram 60). He has *no* gluteus maximus! Our large glutei are entirely the result of standing erect. The ischia are, there-

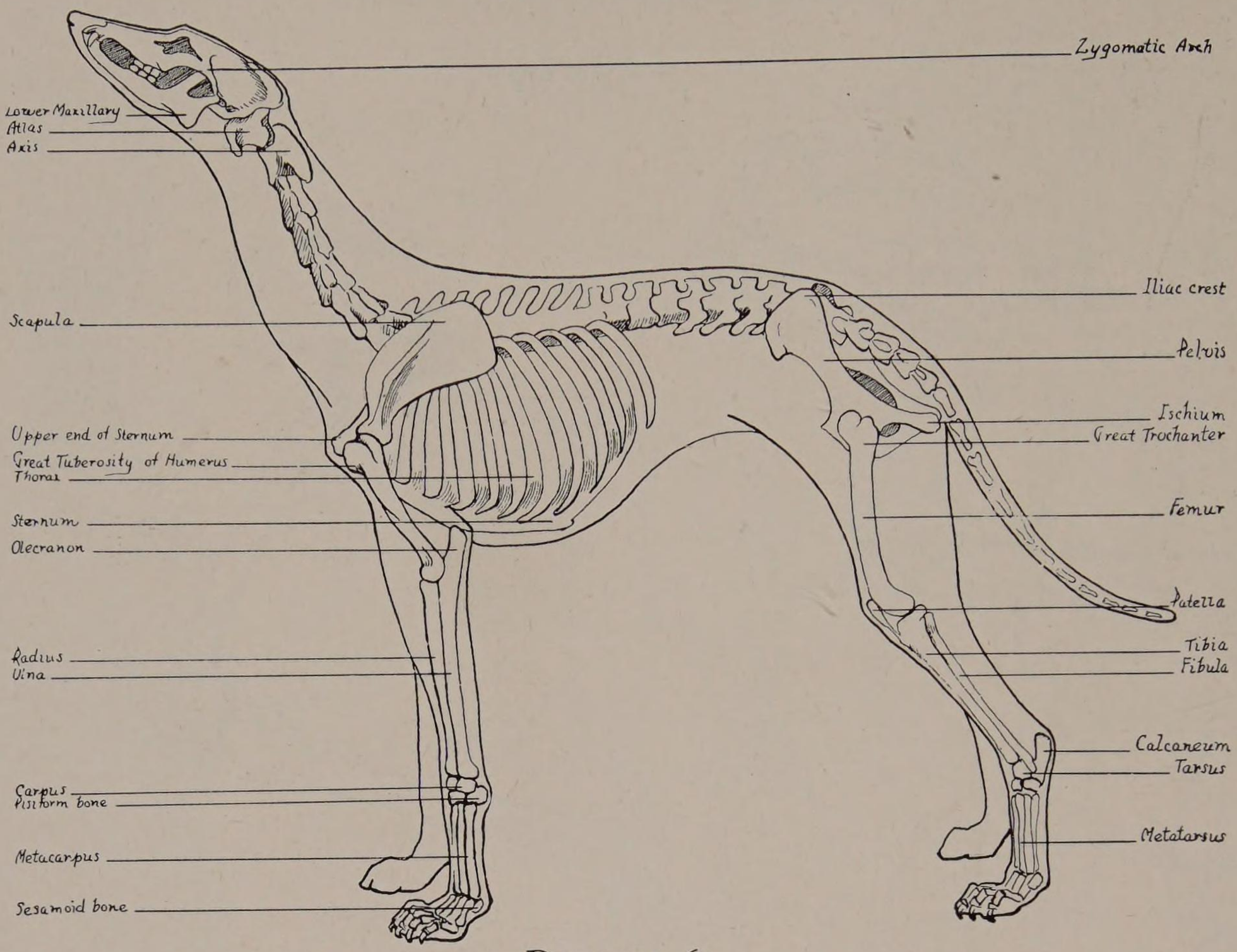


DIAGRAM 62



DIAGRAM 63

Right arm of Lion

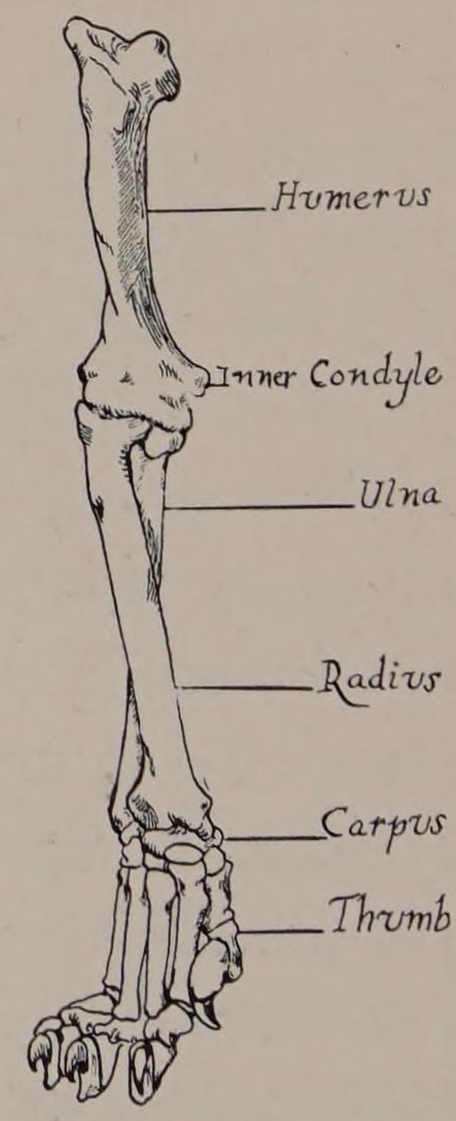


DIAGRAM 64

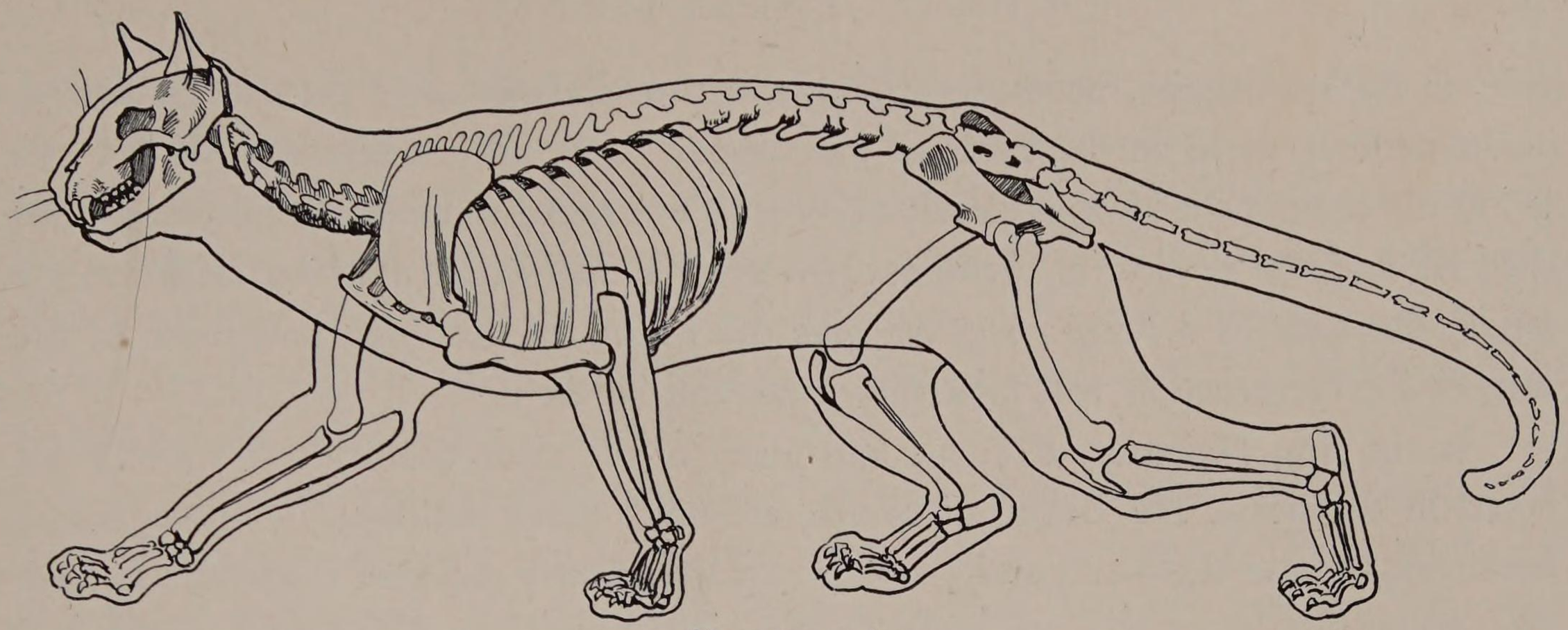


Diagram 65

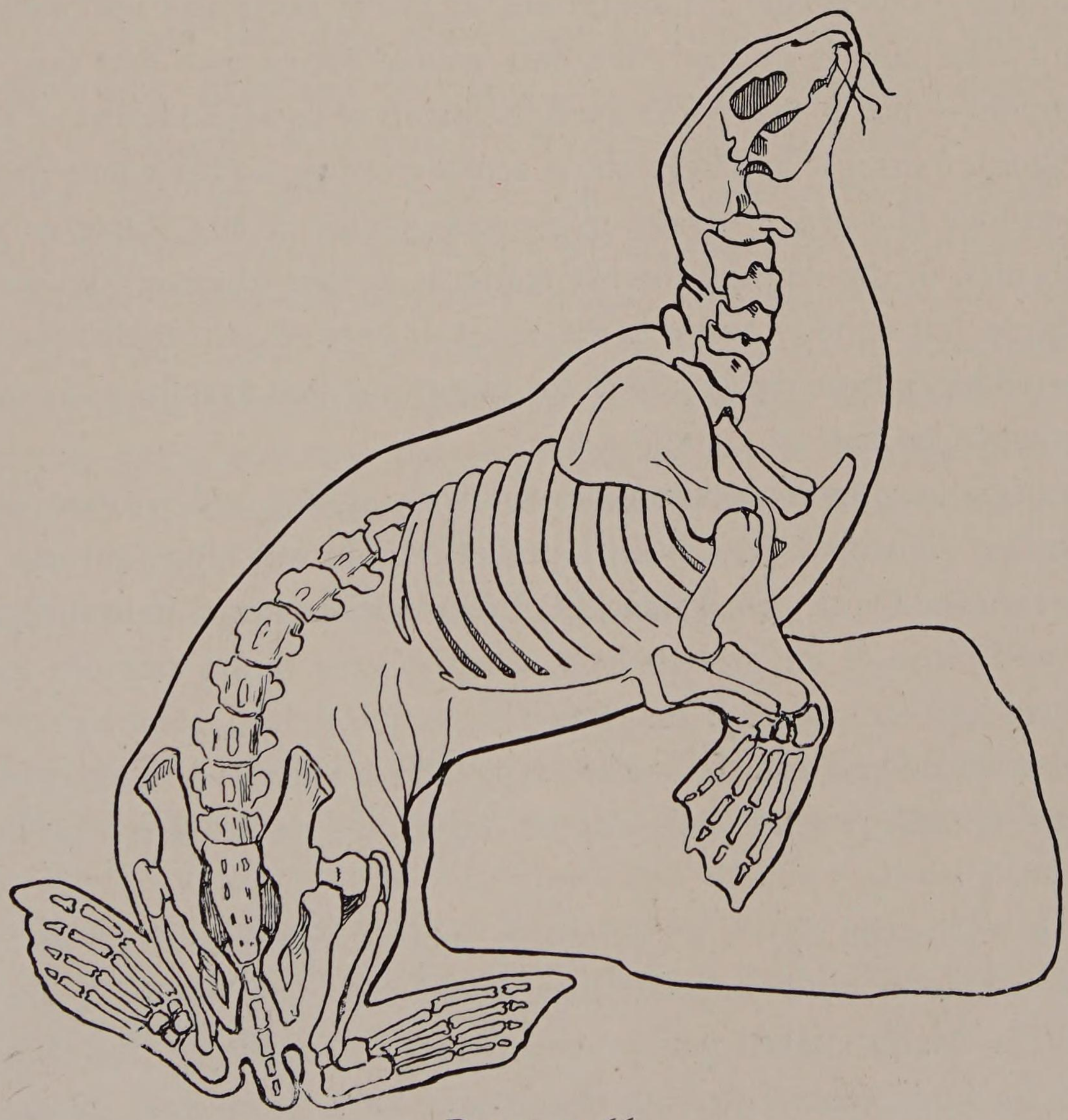


Diagram 66

fore, in the quadruped, uncovered by muscle, though from them grow thick flexors, comparable to those on the backs of our thighs. These flexors, however, do not "tie in" at the back of the knee as closely as do ours, but sweep more directly down toward the calf and the tendon of Achilles. However, a distinction must be made, as we model the back of a horse's leg, between the flexors of the thigh and those of the calf, or the construction will look very weak and wrong.

In the dog (Diagram 62), we find many of the same characteristics which we noted in the horse. His bones, of course, are much more delicate, his humerus and femur longer and slenderer, and his paws not so radically different from ours as were the equine feet. Dogs and cats walk on the *balls* of hands and feet, and thumb and great toe have shriveled to insignificance; but the other four fingers and toes are quite similar to ours. Both wrists and ankles are, as in the horse and ruminants, well off the ground. The bear is probably the only animal except man that may be termed a "plantigrade"—that is, that walks upon the palms of hands and soles of feet. When my little Scottie "sits up" and begs, she is actually resting on her whole foot, in much the same attitude as a native African might squat beside his fire (Diagram 63).

Notice that in the dog the lumbar region is neither concave, like ours, nor flat as in the horse, but arched *upward* in the center. It interested me to discover that *every* vertebrate mammal, from the giraffe to the guinea pig, has exactly seven cervical vertebrae; no more, no less!

Most of us have more opportunities for studying dog and cat than we have for studying horses. One may spend many a profitable hour watching a cat or a dog move about one's studio. Quick pencil sketches of their various poses, indicating their bony structure, will prove of the greatest help, when at some future time one tries in vain to coax them into the pose one has chosen to model. A lean, short-haired dog, be it greyhound or dachshund, is by far the best type for one's first studies, as his construction is so clearly defined. A small fluffy dog or Angora cat would be too baffling for the beginner.

The cat (Diagram 65) is an extremely subtle creature to draw or model. His cousin the lion is in many ways far more sculptural, with his noble head, massed mane, and the clearly marked muscles on his limbs. Diagram 64, showing the build of a lion's forelimb, bears a striking resemblance to our own arm, for the cat tribe, tree climbers all, have powers of pronation and supination like us, and use their front

paws much like hands. The cat's paw is somewhat different from the dog's, in that the last phalanx has a high bony sheath into which the claw can be withdrawn at will, and these sheaths form a distinctive hump on the cat's toes. The cat's movements are a veritable symphony of rhythmic motion. I have always felt that two of the most difficult things in the world to draw properly were a cat and a violin. In both, the curves are so subtle as almost to defy analysis. Even great Leonardo made a miserable failure of cats; witness his sketchbooks.

In deer and cows (which latter are but man-made variants on the deer), the general structure is fairly similar to that of the horse, the major differences being antlers, or horns, and "cloven" hoofs. This expression "cloven" meaning, not that a single digit has been split in two, but that the deer or cow has retained both its third and its fourth metatarsal and metacarpal bones. Thus it walks on *two* fingers and toes. In the cow (poor creature), whose ungainly belly and stunted legs are a result of man's demand for more and more milk, the weight of the belly makes the huge flaring wings of the pelvis even more prominent than in the horse.

While we are on the subject, there *is* one other species of vertebrate mammal which is so frequently misrepresented in sculpture that I feel a few words must be said about it here. This species comprises the seal, sea lion, walrus, etc. Very few of us realize that within their fat blubbery bodies is a complete vertebrate skeleton (Diagram 66). Even though their limbs are bound closely to their bodies, so that only their hands and feet are free, they *are* there, and woe to the sculptor who models his creature without recognizing the bones inside it and who attaches the flippers as though they were the fins of a fat fish! Furio Piccirilli knows his sea lion, inside and out, as his superb interpretation testifies (Plate 112).

BIRDS

One does not often see a bird in the position of the skeleton in Diagram 67, yet it is thus that the eagle has most often been depicted in heraldry, on flags and on coins. I drew this one from a photograph in Gardet's portfolio of animal plates, because it so clearly shows the likeness between birds and human beings. "What?" exclaims the student. "Do you mean to tell me a bird's wing is as similar to our arm as *that?* And does a bird have *knees?*"



DIAGRAM 67

There are two very plausible excuses for our general lack of understanding of a wing. One is, of course, the feathers which tend to obscure the form. The other is the elastic webbing of skin which stretches across from the shoulder to the bent wrist of the bird, causing the casual observer to think (if he thinks at all) that there is but a single bone from shoulder to "hand." But you have only to imitate the pose shown in Diagram 67, flexing and extending your arms once or twice, to know that you are doing precisely what a bird does when it stretches its wings. Even the tiny hairs on your forearm take the same direction as the wing feathers. Actually, hair and feathers are made of the same original substance—modifications of the horny scales of our common ancestor, the lizard.

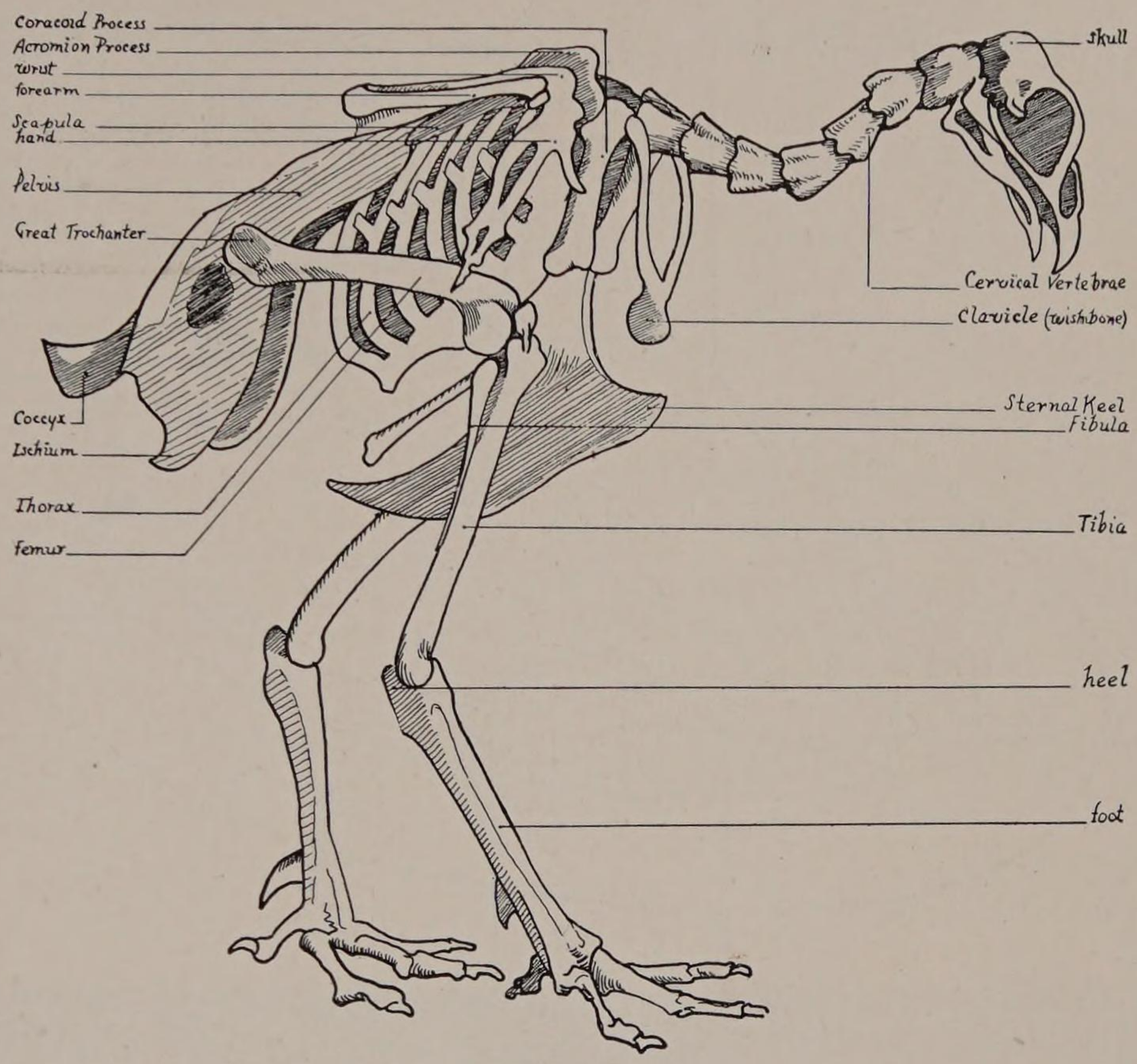


DIAGRAM 68

The bird's two clavicles are welded together in front and quite separate from the sternum. We call them the "wishbone." Its coracoid process (a mere nubbin in man) is developed into a fairly long bone, which does attach to the sternum. This variation is undoubtedly connected with the power of flight.

The sternum of a bird is different from man's, as it has a high projecting ridge, or "keel," obviously adapted for the insertion of the disproportionally developed chest muscles necessary for flying. A bird's pelvis is convincingly similar to that of a mammal, and of course from the pelvic sockets come the two femurs. Here is where the tyro gets lost again. For this thigh of the bird, being almost always buried under the soft body feathers and thus being out of sight, is also out of mind. So the general conception of a bird's leg is that the shin is its thigh and the foot (the scaly part) is its leg, with the knee somehow bending in the wrong direction!

Let us clear up this matter by referring to Diagram 68, which shows the skeleton of a bird we are all familiar with—a chicken. This "X-ray" portrait was made from the mounted skeleton of a young cockerel in the Museum of Natural History. Beginning

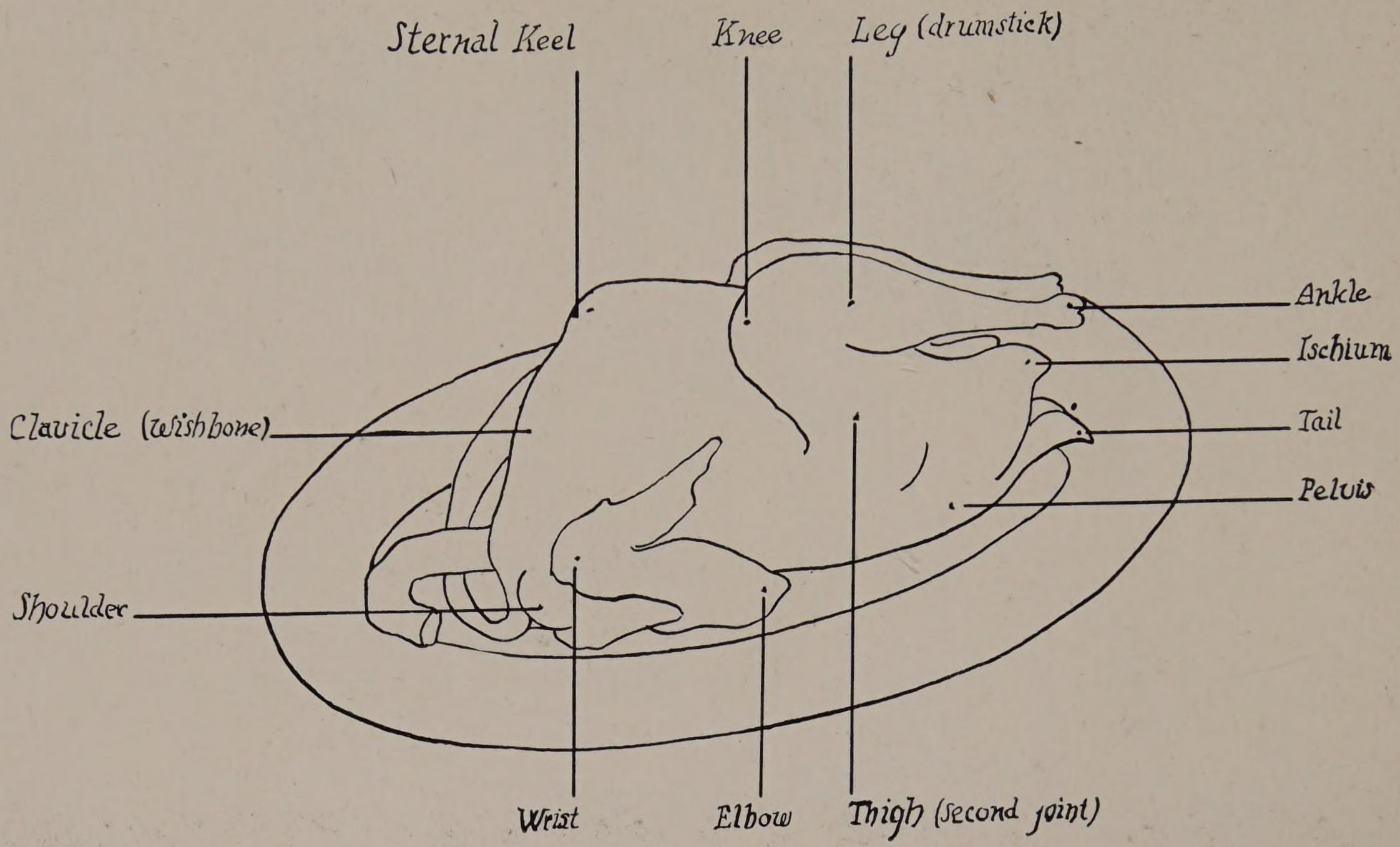


DIAGRAM 69

at the hip socket in the pelvis of this bird, we trace the inevitable femur, slanting forward toward the knee. In gastronomical parlance, this would be called the "second joint." At the knee there is a definite patella, although this is hardly developed beyond the stage of cartilage. Then comes the reverse zigzag, which can only be the *shin,* with its strong tibia and mere splinter of fibula. But ask people what the "drumstick" of a chicken is, and ninety-nine out of a hundred will tell you it is his thigh! Below that shin inevitably comes the *foot,* the scaly part which most people call "legs" when they ask the butcher to cut them off. For the chicken, like cat and dog, walks on the *ball* of its foot, with the great toe turning backward and opposing the others, so that he can perch on a branch by clasping it with his toes.

It is interesting, I think, to see the astonishing variance in size and length between the wing (or arm) of an eagle—born to soar tirelessly in the air—and the man-made chicken, whose poor wings are so stunted that he can barely lift his heavy body off the ground. His ancestors were game birds, able to fly long distances; but just as man wanted more milk from the cow, so he demands more and more eggs from the hen, and as a result the bird's wings are slowly but surely disappearing.

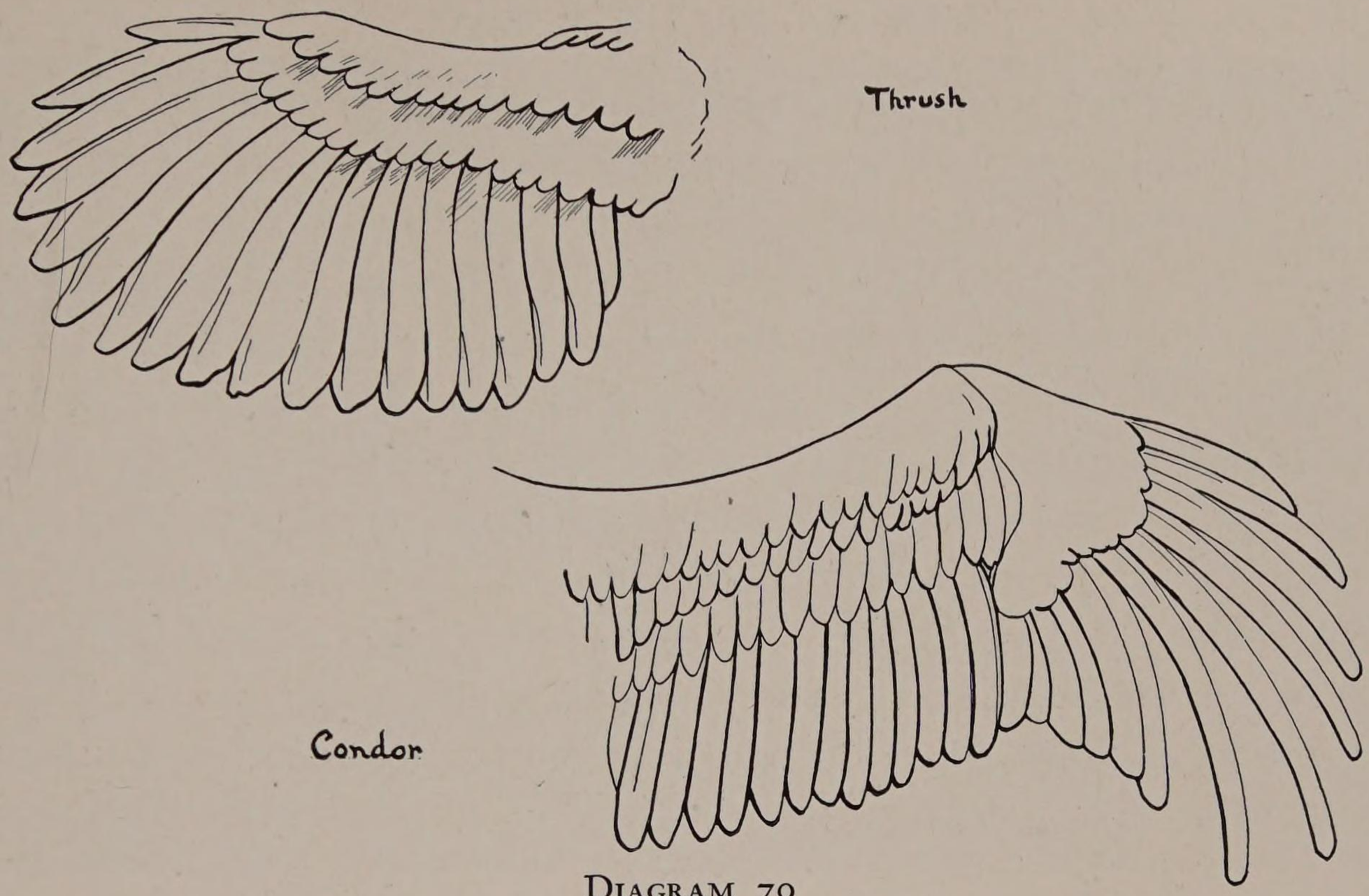


DIAGRAM 70

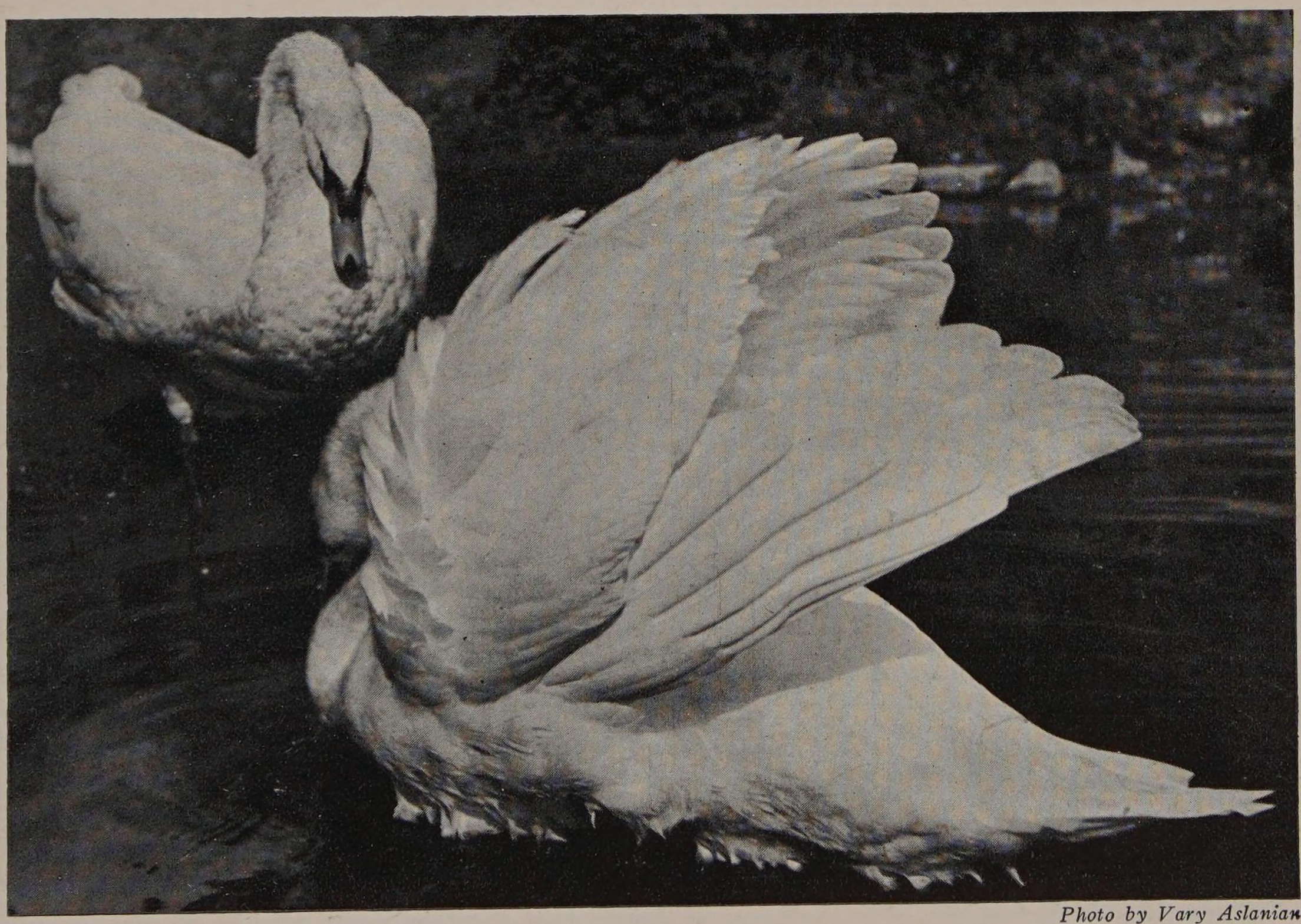


Photo by Vary Aslanian

PLATE 107. Swans

In case you are not yet wholly convinced about the shin-drumstick idea, let me give you "chicken" in Diagram 69, minus head and feet, plucked, dressed and neatly turned upon his back ready for roasting. Does this look more familiar?

Only in the outstretched wing of some large bird like the condor or the pelican can the sculptor fully grasp the construction and pattern of the groups of wing feathers, as they grow out from arm and hand, but even in a little bird, the design is always the same. Diagram 70 shows the outspread wings of a thrush and a condor. Note the clear demarcation of each group or layer of feathers. Note also that the outermost feather of the wing is never the *longest* (a very common error), and that in the long quills the rib never runs down the center, but always nearer the outer edge of each feather. I have never seen feather formation better illustrated in photography than in this prize-winning picture of swans (Plate 107). And do you not agree that the *construction* here is a part of the *beauty?*

FUR AND FEATHERS

The interpretation of fur or feathers is very largely a matter of personal taste among mature artists. Once they have mastered the *handling* of it they will always indicate the *form* of the principal masses of fur or hair, and yet may prefer not to indicate the *texture* by so much as a single toolmark. Alfred Pompon, the great French animal sculptor, simplified his surfaces to the "*n*th" degree, and yet, glancing at the picture of his polar bear (Plate 109), we are none the less convinced that we are looking at an animal completely encased in a coat of heavy fur. Pompon told me that when he modelled animals, he kept as far away from them as possible, so that he would not become confused by detail. It is probable that Hernandez works the same way, for not an unnecessary form breaks the great simple planes of his noble animals (Plate 111). But with him, this must also be because he hews his figures directly in the hardest stones and granite, which naturally precludes any elaboration of detail.

That this is not the *only* way, however, to interpret animals is proved by such sensitive and understanding modelling as is characteristic of our own sculptor, Gertrude Lathrop, whose bronze "Saluki" is here reproduced (Plate 110). Miss Lathrop truly *designs* the fur on her creatures, thereby accentuating rather than minimizing the various textures. She works primarily for bronze, Pompon and Hernandez for stone. Who shall say which is the better?

Certainly it behooves the student to learn the *construction* of fur at the start,

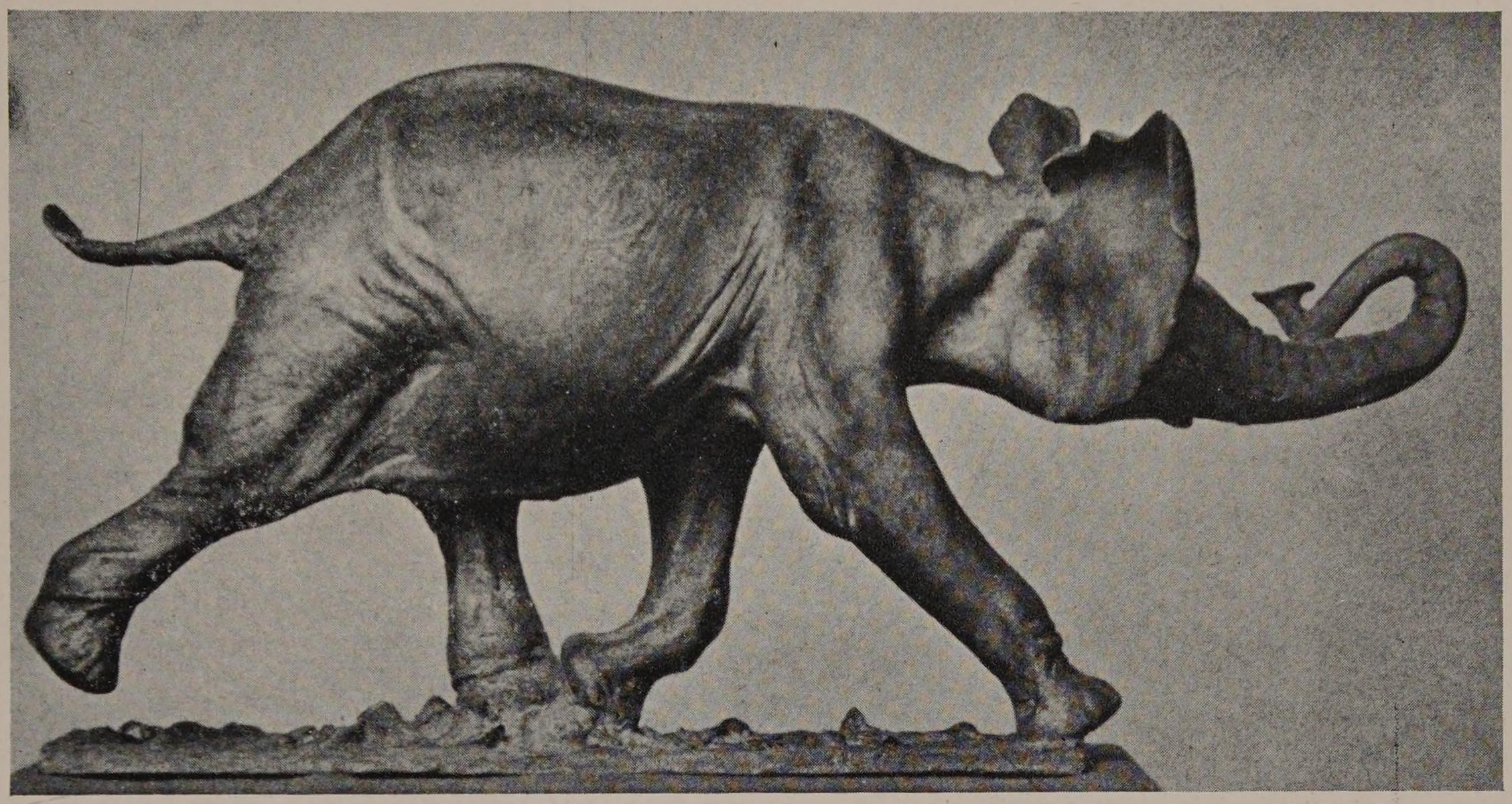
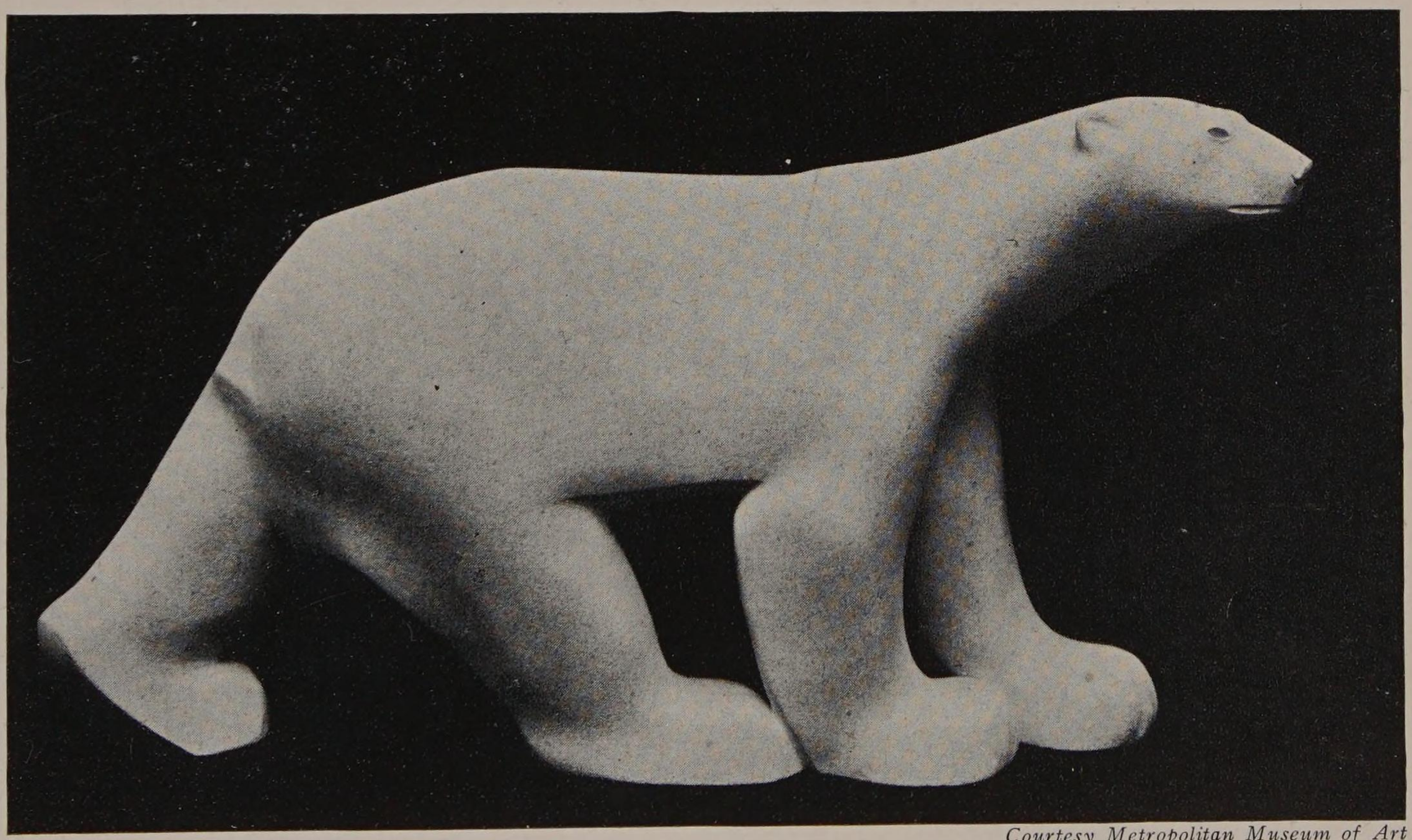


PLATE 108. "Running Elephant," *Bronze*. Anna Hyatt Huntington



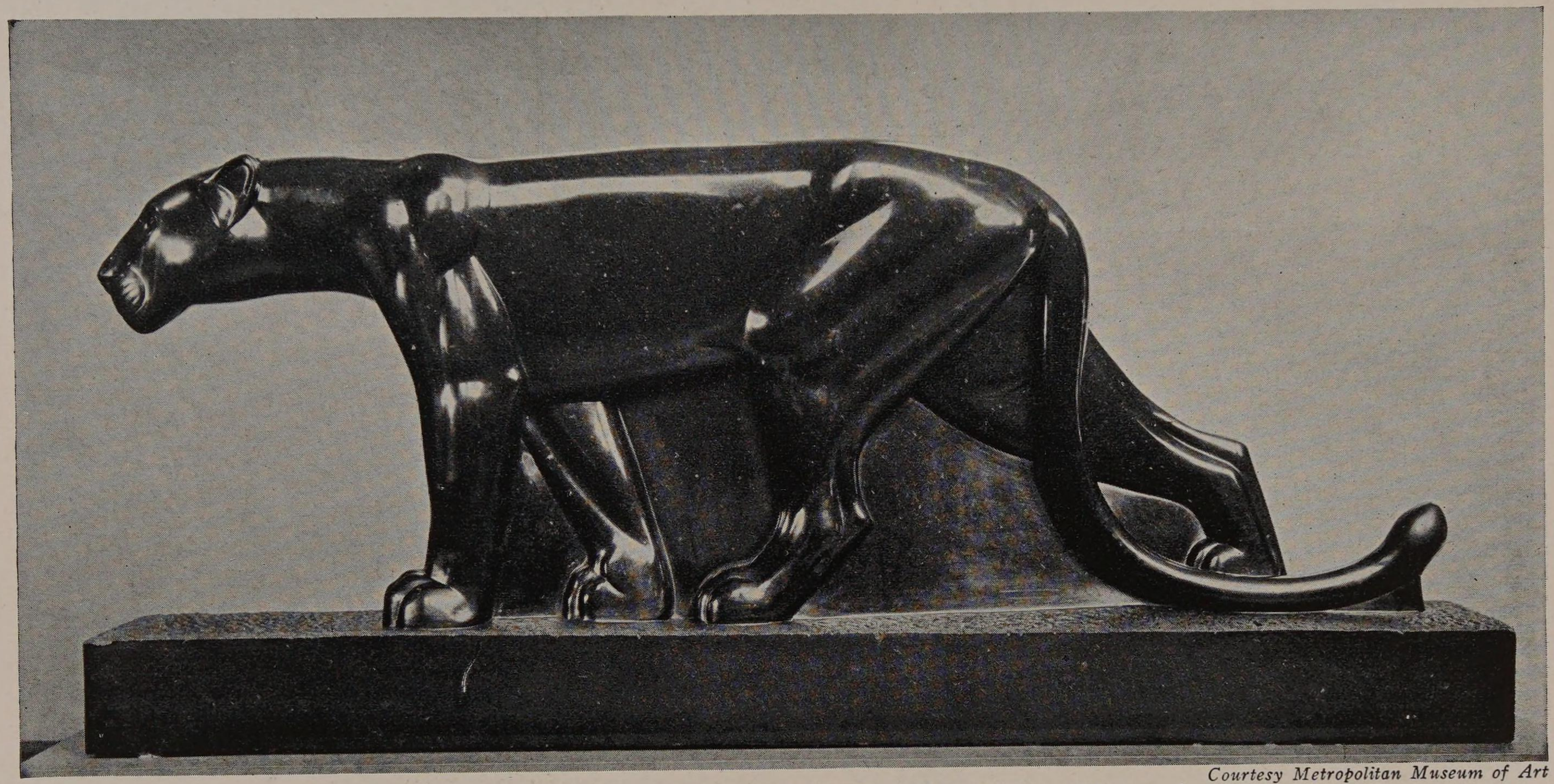
Courtesy Metropolitan Museum of Art

PLATE 109. "Polar Bear," *Marble*. Alfred Pompon



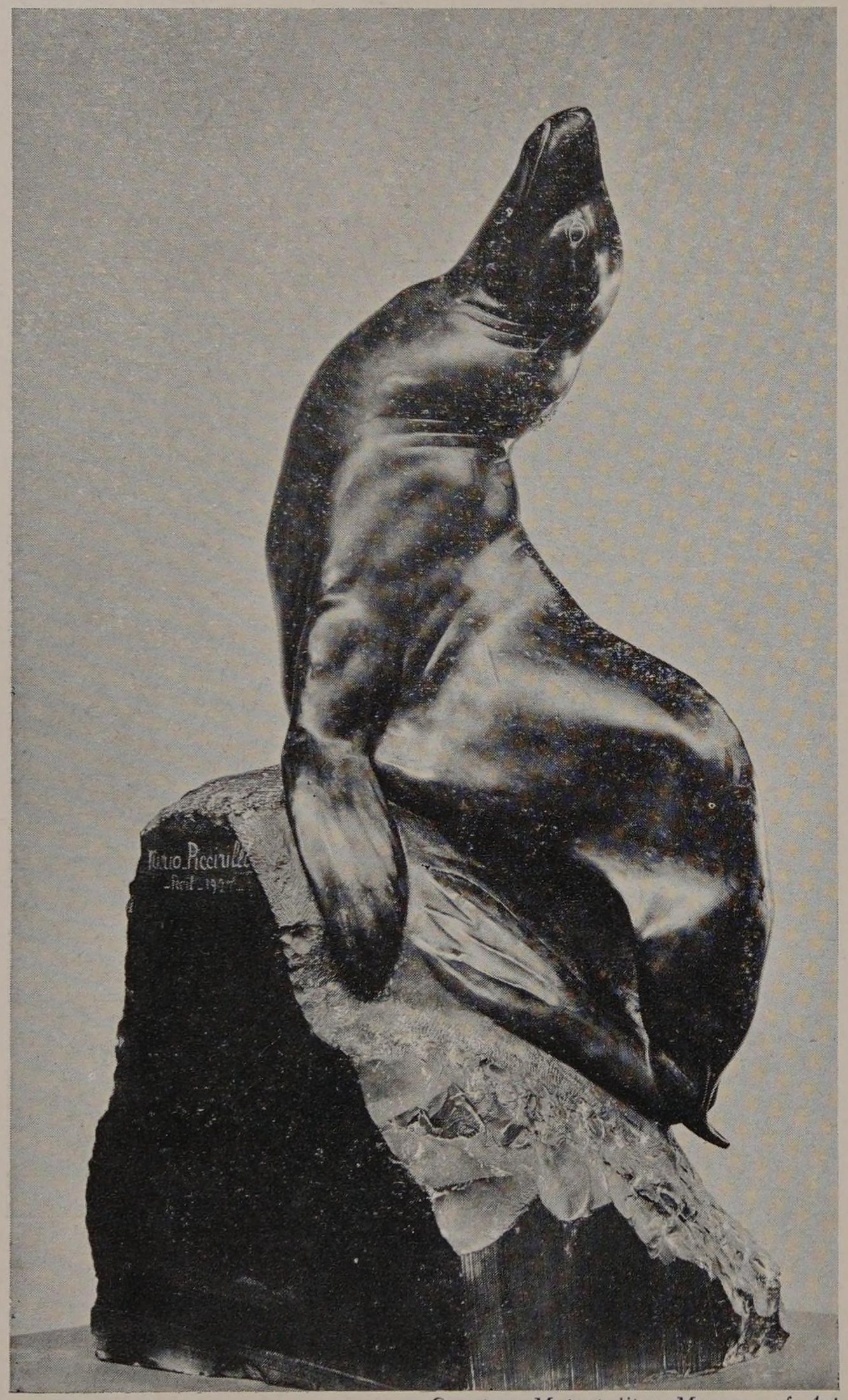
PLATE 110. "Saluki," *Bronze*. Gertrude K. Lathrop

whichever way his tastes may lead him in the future. With a collie dog, for instance, the fur grows in a number of fairly large masses, and the direction of the hair will be seen to vary with each mass. Where two such directions collide, the masses will meet in a ridge, and where they diverge, the form of the dog may usually be felt underneath. Just a stroke or two of the tool at the ends of these hair masses should suffice to indicate hair. *Too many* tool scratches will make your work look like those unconvincing little wooden bears which are sold in such quantities to tourists in Switzerland



Courtesy Metropolitan Museum of Art

PLATE III. "Panther," *Black Belgian Marble.* Matteo Hernandez



Courtesy Metropolitan Museum of Art

PLATE 112. "Sea Lion," *Marble.* Furio Piccirilli



National Museum, Naples

PLATE 113. Deer, *Antique Bronze*

and the Tyrol. Such scratching does not really suggest fur at all, because fur always has its big planes, like human hair, where the light *wipes the surface clean.*

For further information about the modelling of animals, you must look elsewhere. All I have attempted to do, and indeed all I feel equipped to do, is to make the student realize the analogies, the relationship, between humans and animals, and to open his eyes to a few of the marvels of nature. This chapter merely suggests a line of approach to the study of animal anatomy and animal sculpture.

CHAPTER IX

MODELLING AND CASTING A PORTRAIT HEAD

PLATE 114 is a very beautiful example of a Roman copy of an ideal Greek head.* Based on a perfect oval, this head was probably not intended as a portrait. It is a composite of all the qualities which the Greeks considered supremely beautiful.

Contrast this with the grim but infinitely human Roman portrait in Plate 115. The one gives us the standard, while the other gives us one of life's variations upon it. Portraiture is a matter of knowing the norm and of appreciating the variant.

For your first portrait you should select someone with strongly marked features; preferably a mature man with plenty of character; and smooth-shaven, so that mouth and chin may be clearly seen.

Before you begin modelling, take plenty of time to study and analyze his individual characteristics. Is his head long, broad, square, round? Is his profile convex or concave? Are his eye sockets deep, with the surrounding bone clearly indicated? Cheek-bones wider than jaw? Jaw wider than temples? Forehead prominent or receding? Nose short or long? Neck strong and columnar, or weak, stringy and thrust forward? Ears set high or low? Skull highest at the back or toward the front; long from front to back, or high and narrow?

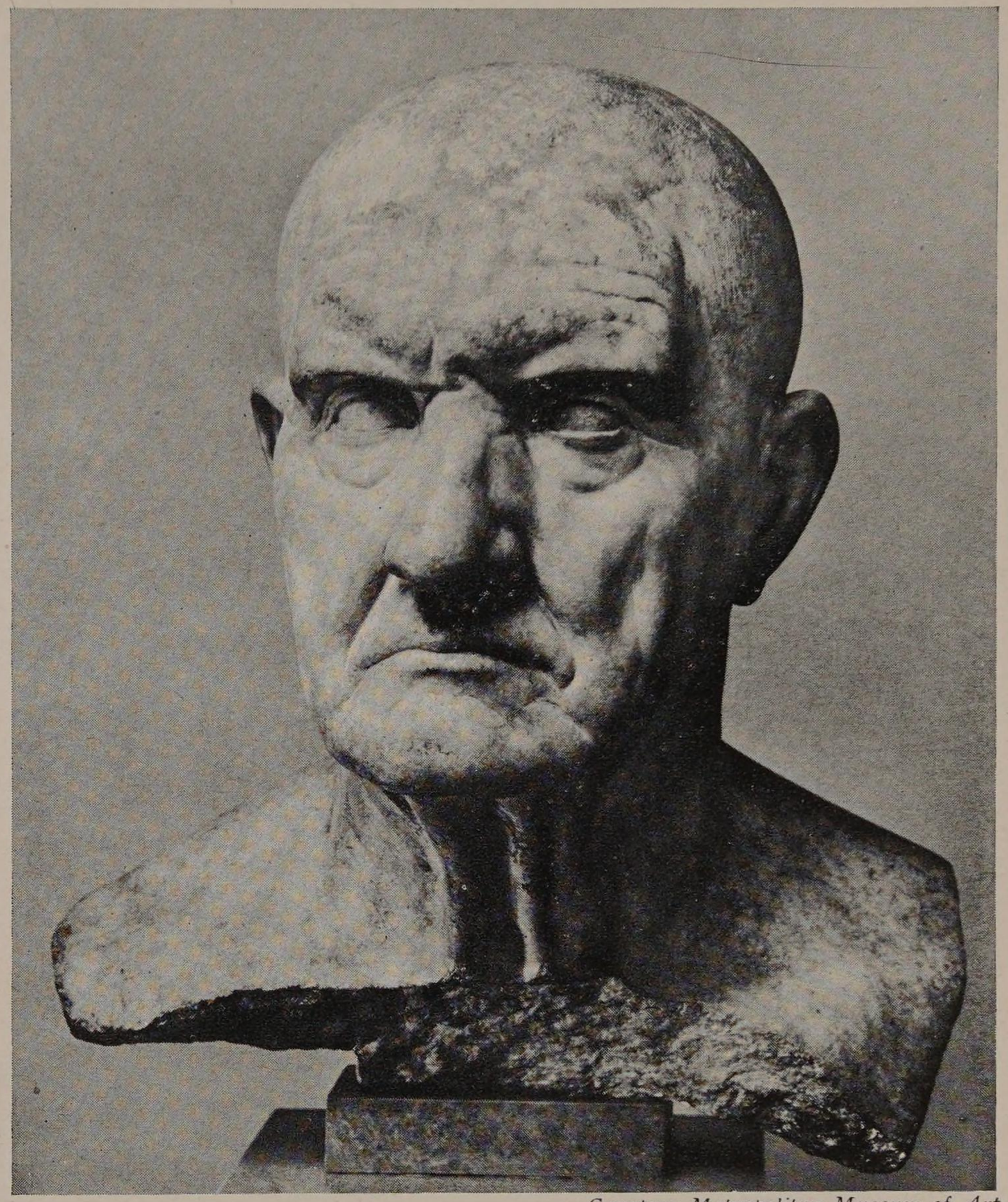
In other words, size-up your sitter, not only as to the shape of head and features, but as to his mental and spiritual make-up. If he is a powerful man of action, decide what forms and directions combine to give this impression and stress those for all you are worth. If he is a quiet, thoughtful type, analyze the forms that speak this character and concentrate on them. For it is the forms that tell the tale. Expression is no mere surface matter. It depends upon basic construction.

*Plaster casts of this and of the Roman busts may be obtained from the Metropolitan Museum of Art.



Courtesy Metropolitan Museum of Art

PLATE 114. Head of Athlete, *Marble*.
Roman Copy of Greek Work



Courtesy Metropolitan Museum of Art

PLATE 115. Roman Portrait, *Marble*

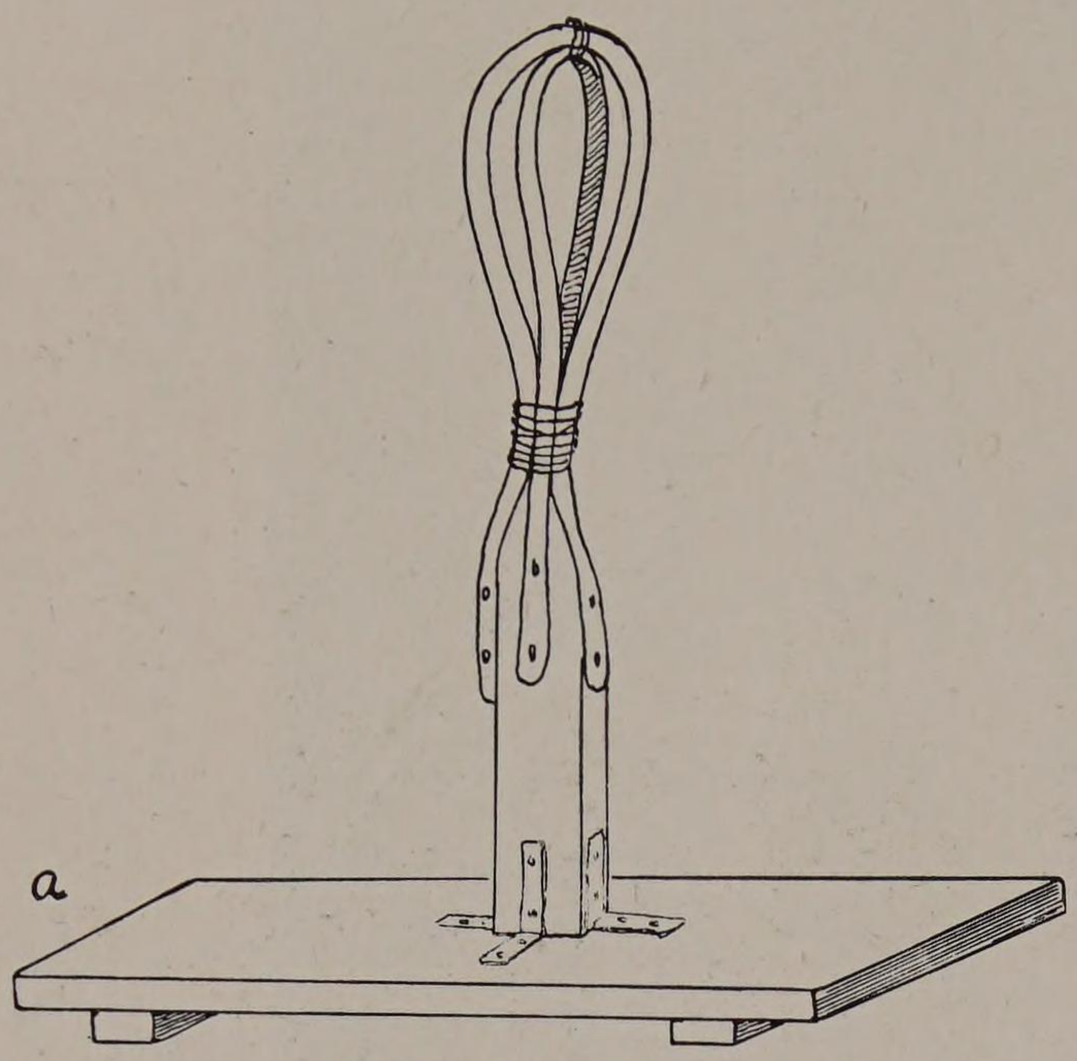


DIAGRAM 71

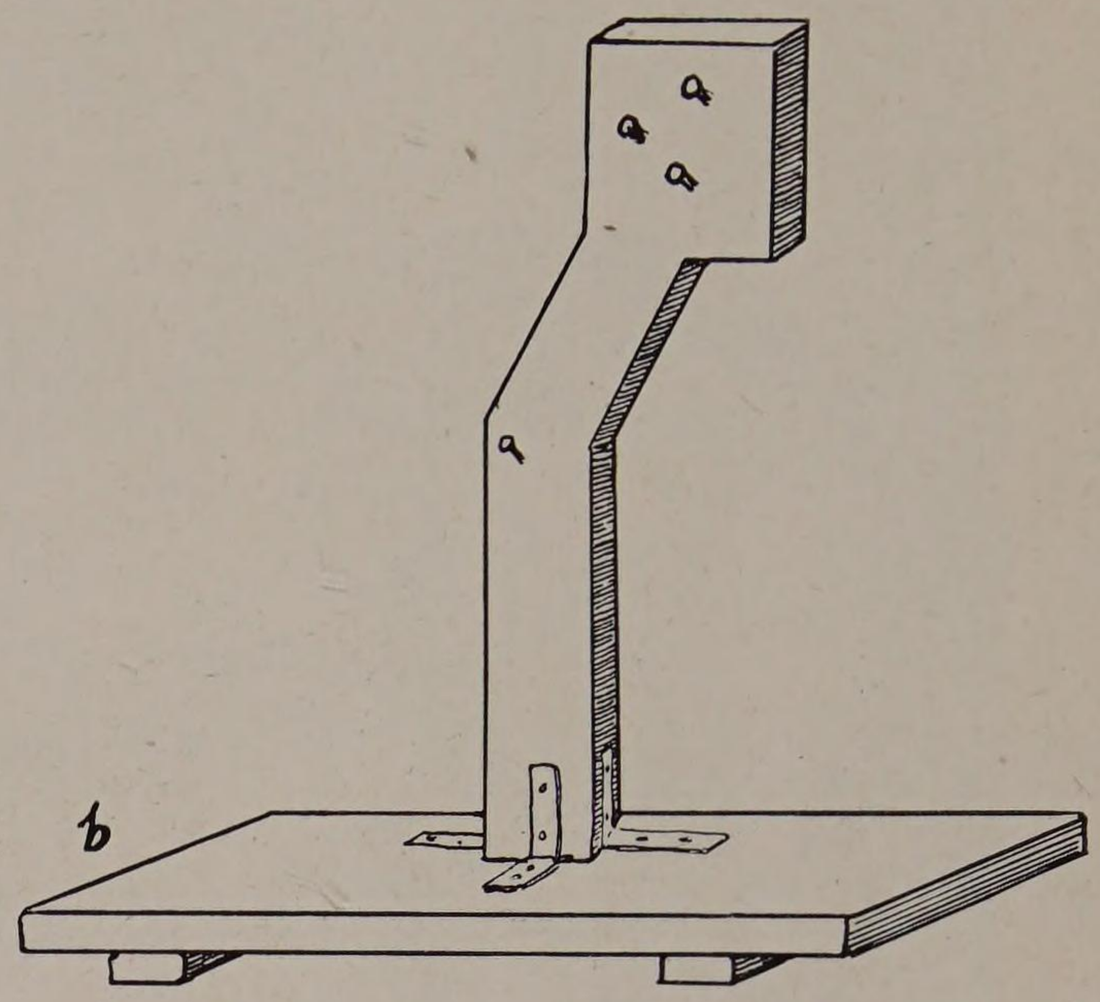


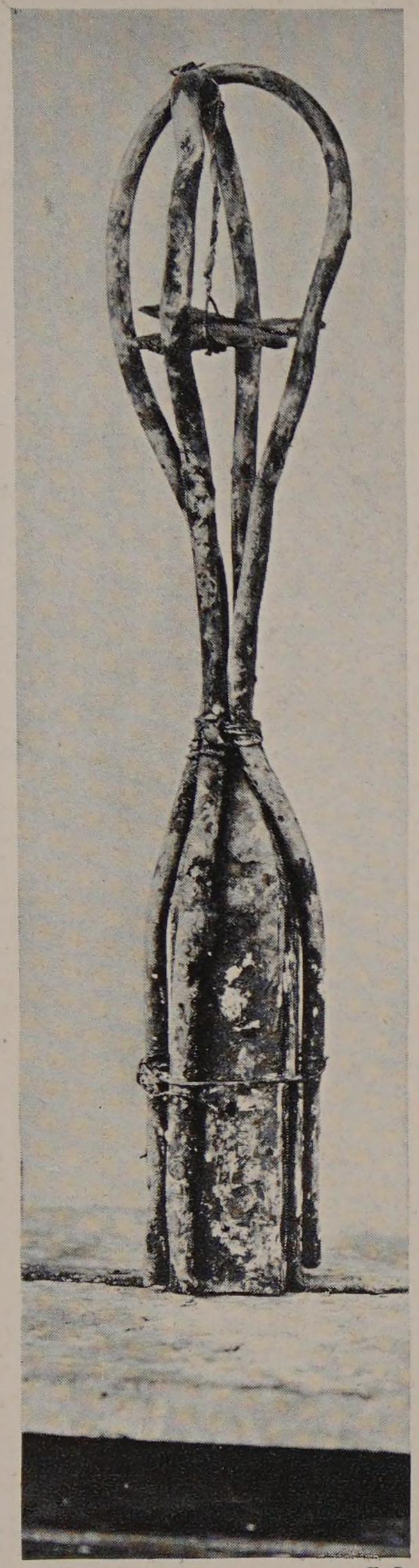
DIAGRAM 72

Diagrams 71 and 72 show two different types of armatures for use in portrait sculpture. Diagram 71 resembles the one used for the demonstration in this chapter. To the wooden upright are fastened two loops of lead or "compo" wire, forming the neck and head. The advantage of this is that even after the first clay has been packed on, one can still make changes in the direction of the neck and head by pulling or pushing them this way or that.

When your sitter first begins posing, he is apt to hold his head very rigidly and unnaturally, and only after he has become completely unself-conscious does he relax into an easy and natural pose. With a flexible armature we are able to modify our work accordingly, and make neck and shoulders, as well as head, characteristic of this particular man.

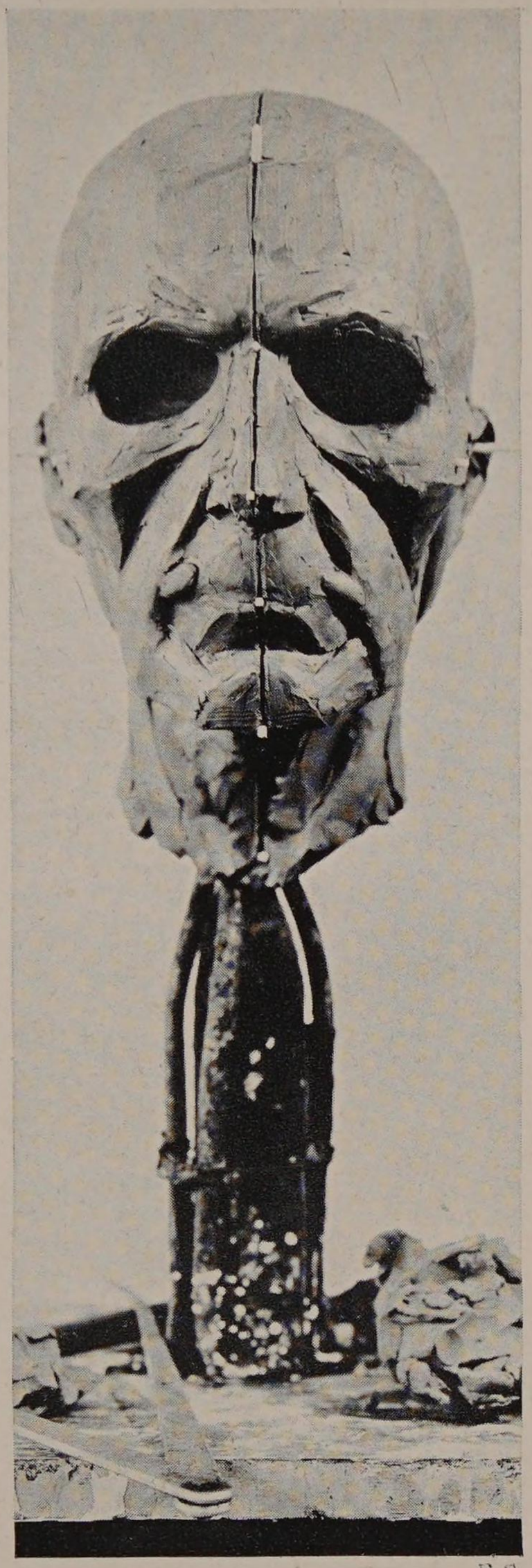
The all wooden armature in Diagram 72 would be especially useful for a massive head thrust forward from heavy shoulders. Lead wire might collapse under the weight of the clay, but the single piece of wood will support a great weight.

Assuming, however, that you are using a lead-pipe armature, your first steps should be as follows: Have your sitter stand (or sit on a high stool) close beside your modelling stand. Engage him in conversation, or let him watch you puttering with wires, clay bats, or tools, until he has forgotten that he is posing. Once you have discovered the natural position in which he holds his head, adjust your lead loops to



E.S.

PLATE 116
The Armature



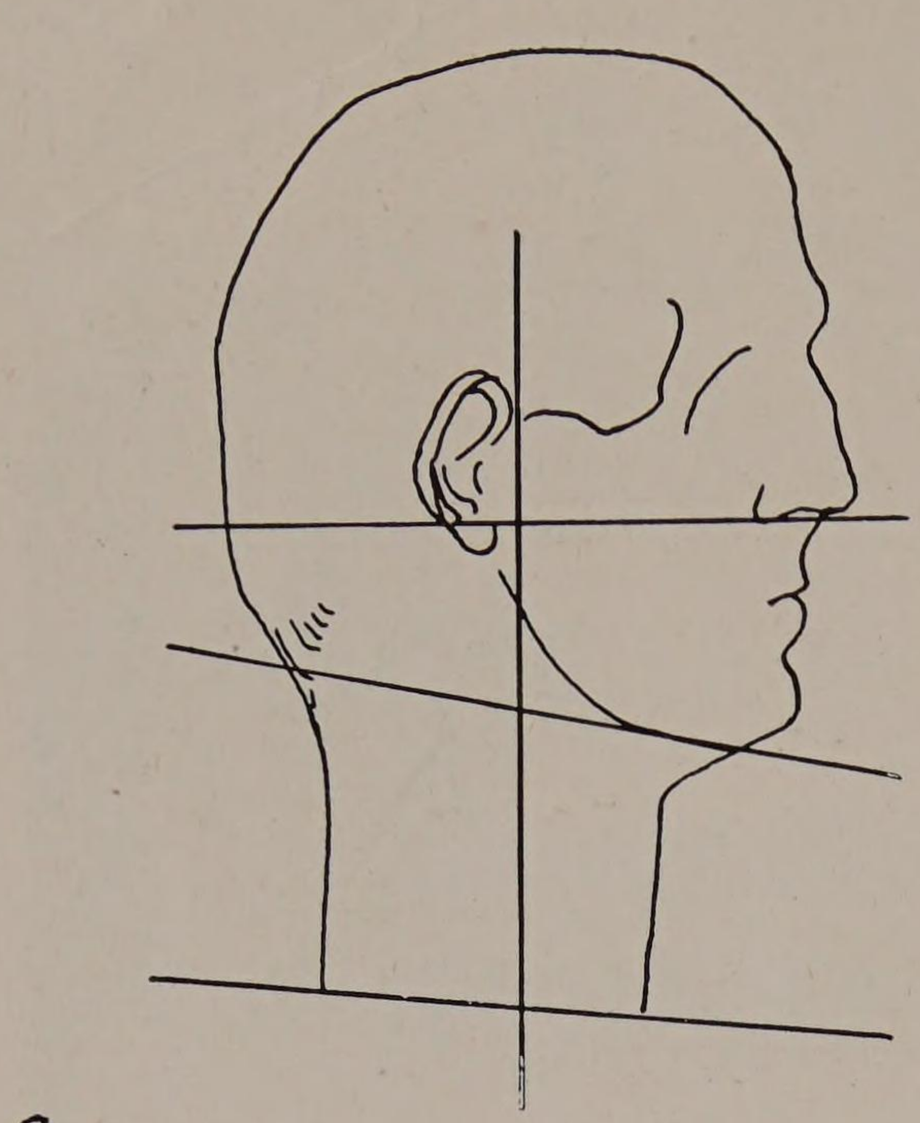
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PLATE 117



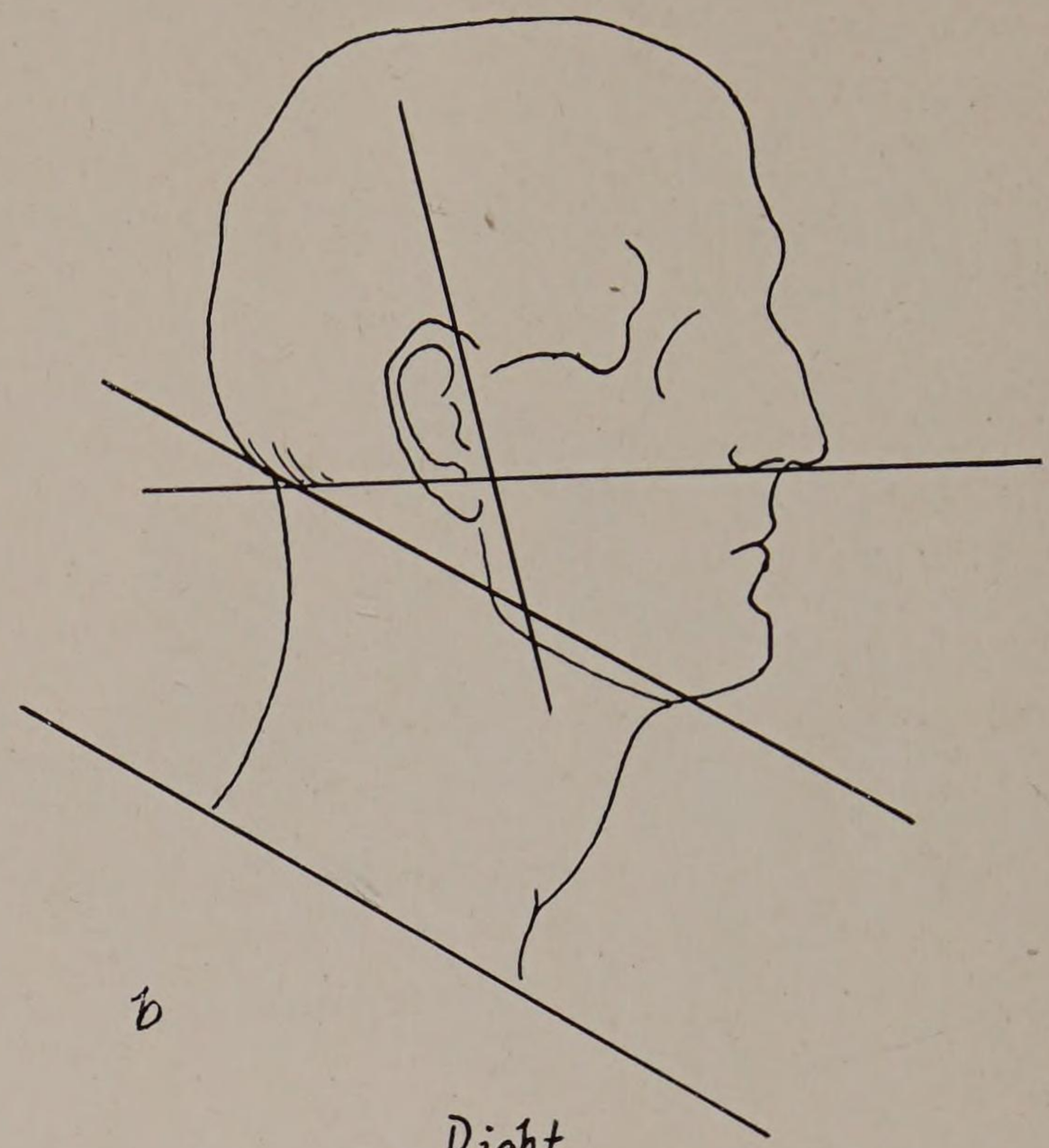
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PLATE 118
The Head with Main Forms Blocked In



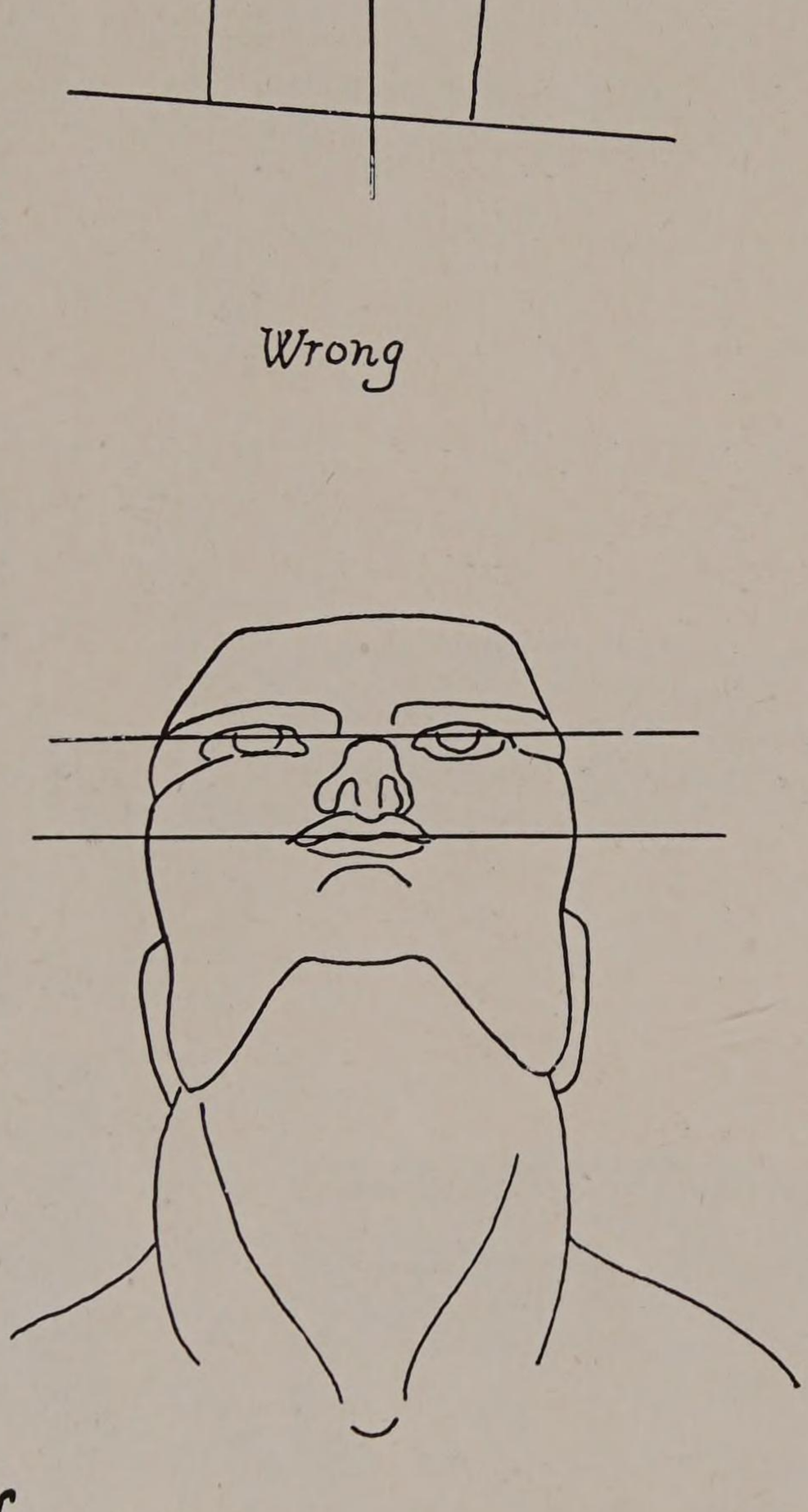
a

Wrong



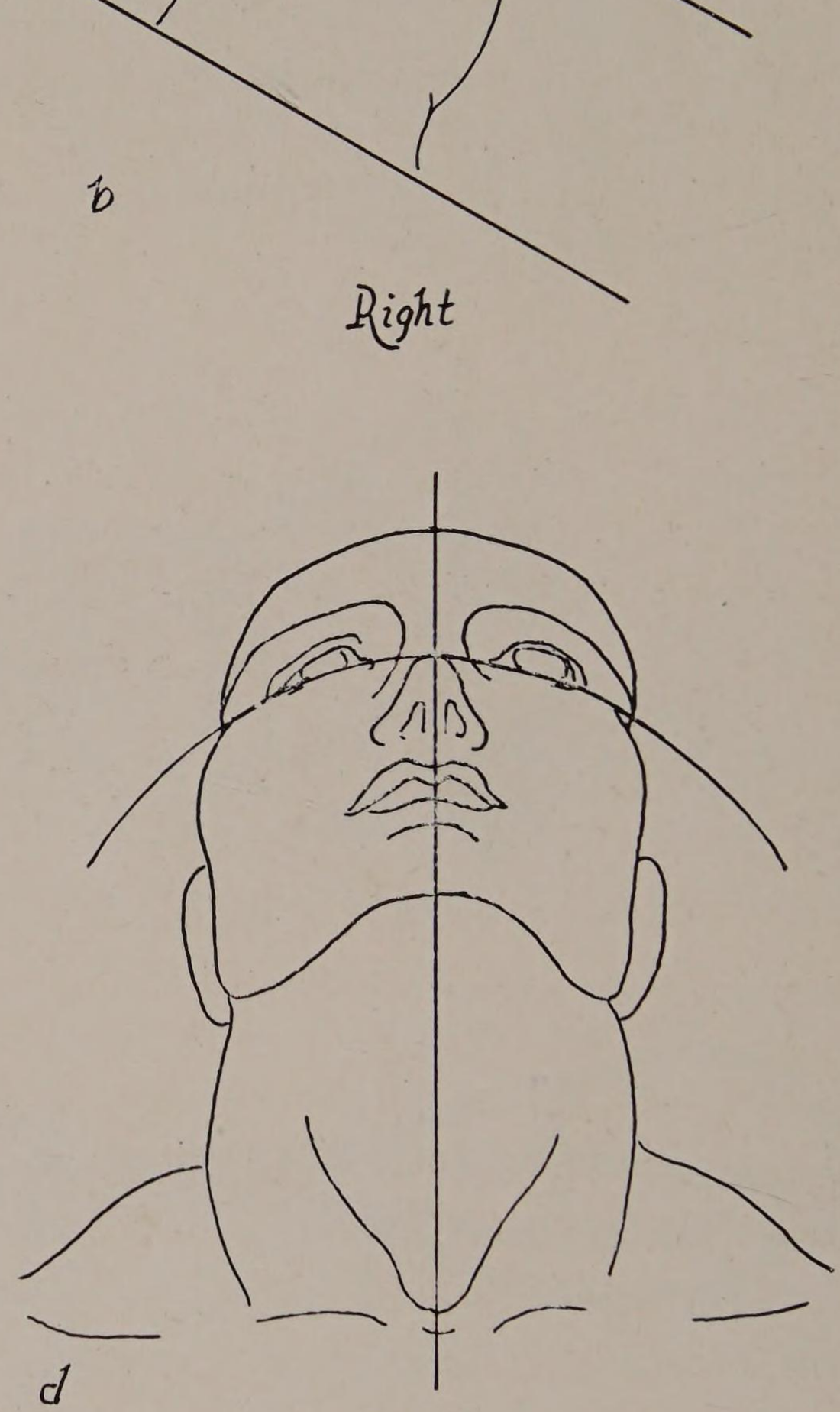
b

Right



c

Wrong



d

Right

DIAGRAM 73

correspond. Now begin packing on the clay, and as soon as you have a compact (though still undersize) mass which can be measured and drawn upon, take some measurements. It would be well to avoid bothering your sitter unnecessarily, by writing down such measurements, so that you can refer later to them, instead of remeasuring him. Be especially careful not to endanger his eyes by jabbing too close with the calipers. Once you have established on your armature the pit of the neck, it is well to take most of your measurements from this point, for it lies fairly close to the armature and cannot be readjusted as easily as the head itself. Only *major* measurements, such as pit of neck to top of head, length of face, distance from back of head to chin or nose, etc., need to be made until you have the whole "box" massed in (Plates 117 and 118). Leave the eye sockets hollow at first, so that the main construction is plainly in evidence until you are ready to tackle the modelling of the flesh forms. Use wooden matches to mark your measurements, so that you will not lose sight of them as you add clay.

Above all, keep turning both sitter and clay model every few minutes, so that you are working on all parts of the head almost simultaneously. The danger is that you will become so interested in the features that you will forget the back of the head, which, sculpturally speaking, is of equal importance. Lest you disagree with me there, let me remind you how often we can recognize a friend, even without seeing his face, by the shape and carriage of the back of his head and neck.

Diagram 73 will, I hope, warn you against a few of the almost universal mistakes made by beginners when attempting a head for the first time. In "*a*" the neck is too straight, the base of the skull far too low and the ear set wrong. In most people, the direction of the forward part of the ear is in line with the nose. "*c*" shows a mistake common to *all* beginners. Forgetting that the face is an oval, the student makes a single flat plane of the face, upon which he superimposes the features. Indeed, this blunder is all too prevalent, not only among tyros but among those whose experience should certainly have taught them better. There is hardly a single sculpture exhibition that has not at least one such "boner" in it!

Still another is that shown in Diagram 74. Endeavoring to make an "aspiring" creature with swanlike neck, the young sculptor totally forgets (if he ever knew) that the head is a solid box mounted on a flexible column (Diagram 75). He uptilts the *front* of the box, but fails to tip the rest of it, with the sad result that he dislocates the lady's jaw!

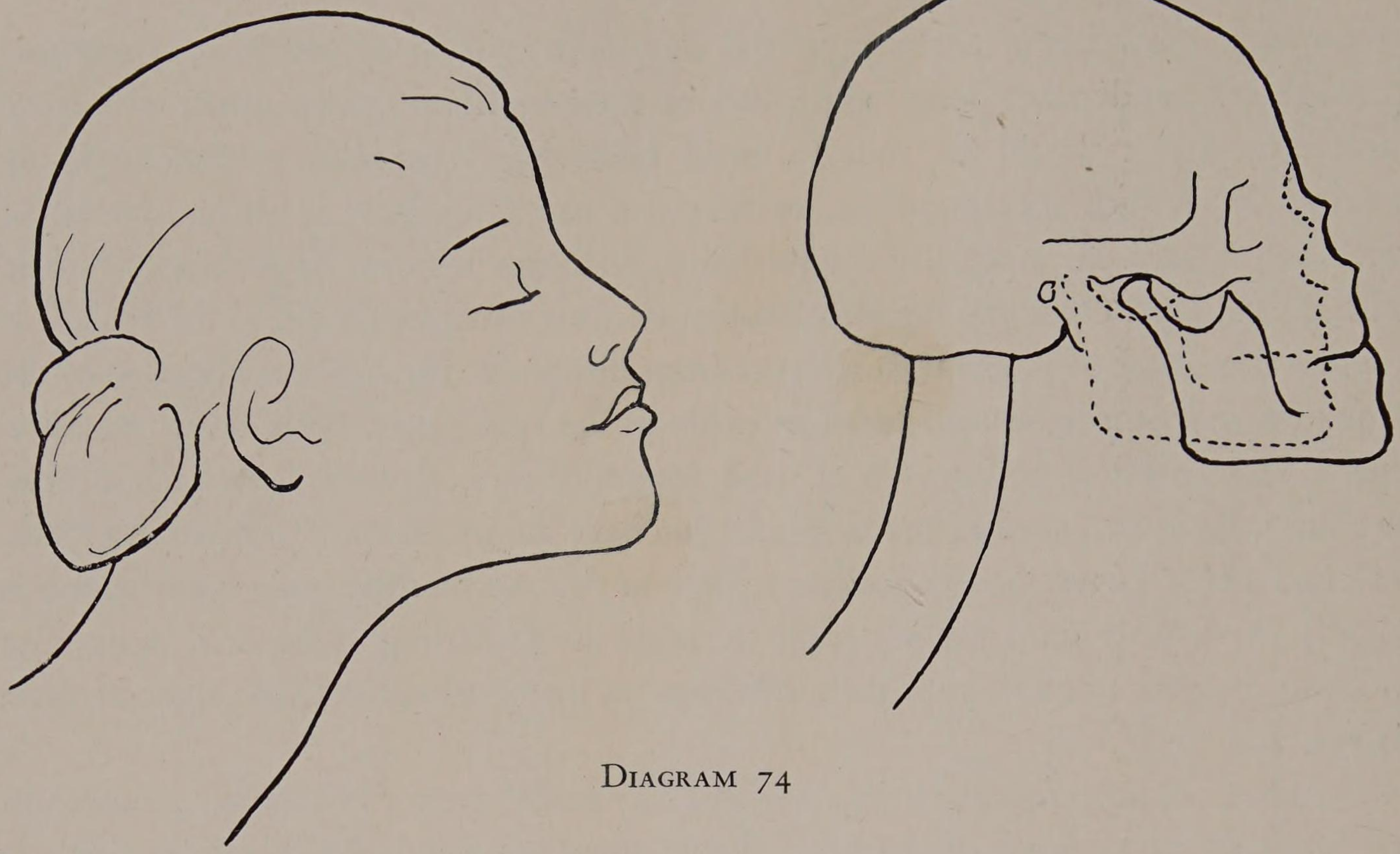


Diagram 74

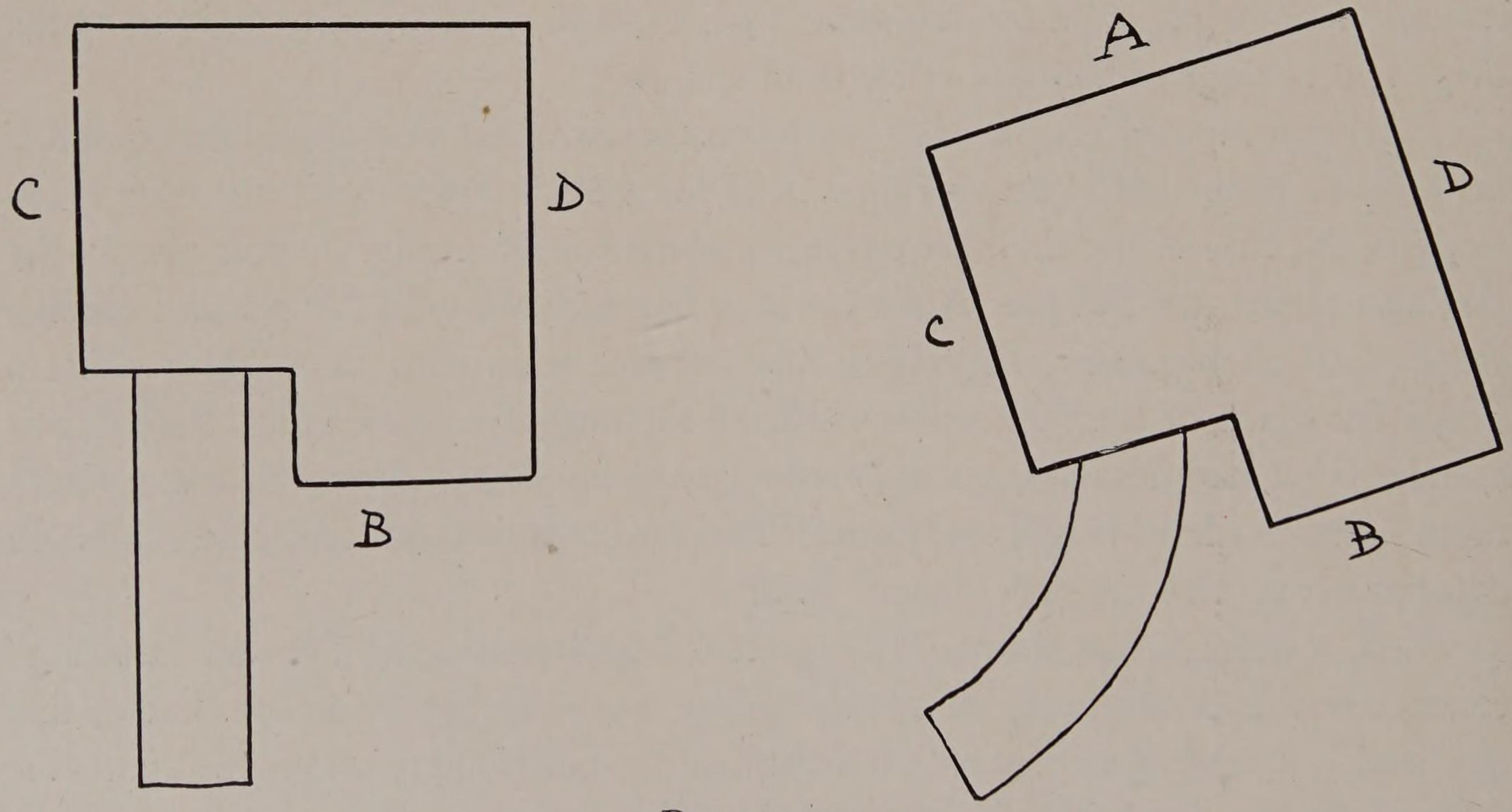


Diagram 75

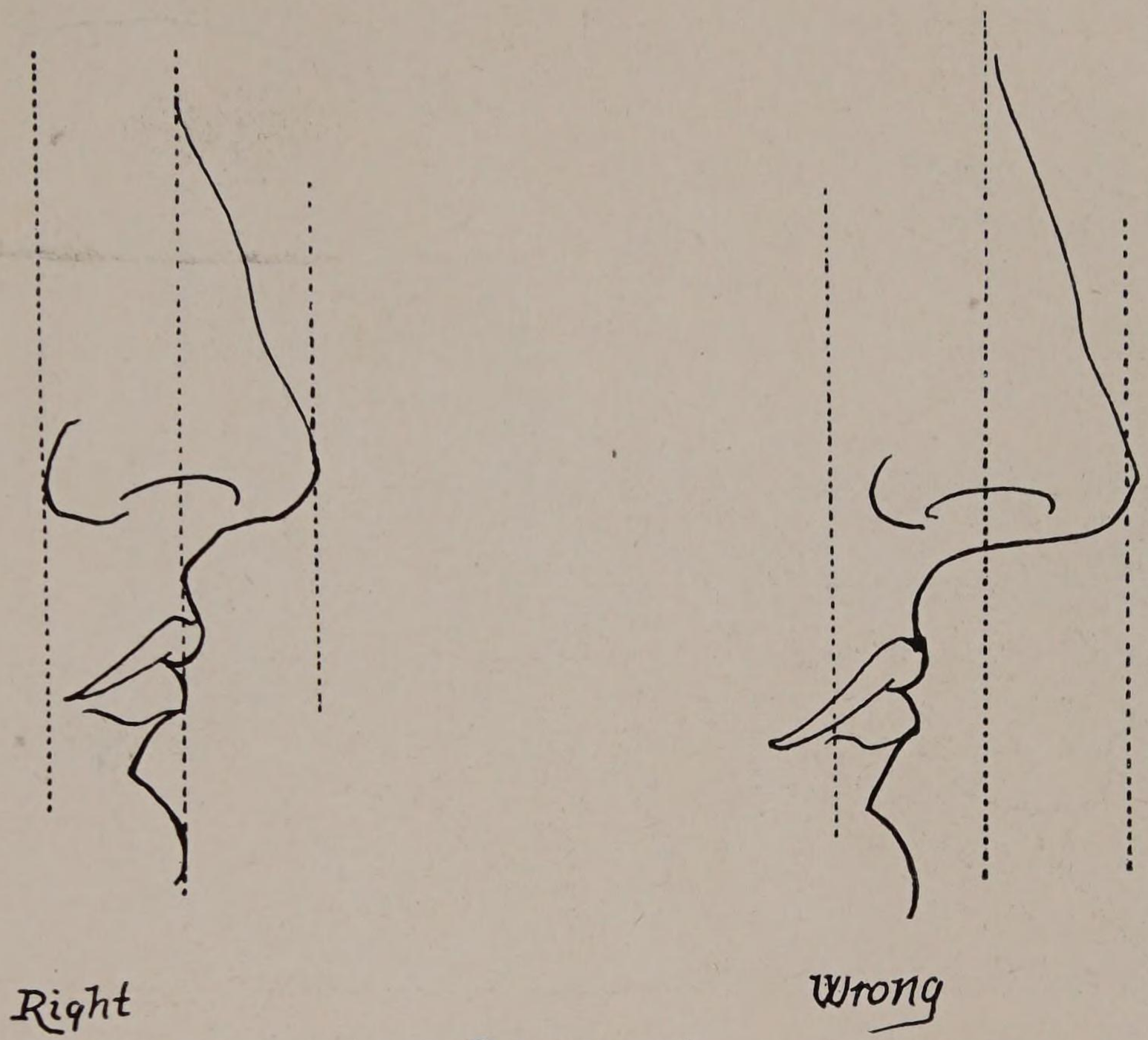


DIAGRAM 76

While you are working on a portrait ask your sitter occasionally to throw his head back as far as possible. This will enable you to see clearly how the two sides of the face slope away from the central ridge. Note how even eye sockets and eyes, as well as the horseshoe build of the teeth and chin, follow the same curve.

The student almost invariably sets the eyes too close to the nose, giving them a slightly cross-eyed look, and making the bridge of the nose pinched and meager. Give ample space for modelling here, plenty of room for the two "ramps" which lead up from the cheeks to the nose ridge.

Turning for a moment to the profile, I should like to point out a fact about noses which is seldom understood by the beginner, viz., that the nose is set as far back *in* the face as it projects *from* it. That is, the upper lip grows from under the nose halfway between the back of the nostril and the tip. Diagram 76 illustrates this point. The nose must never look as though it had been stuck onto the face, as it most assuredly will if this rule is broken, especially if the planes of the cheeks fail to recede from the center of the face as they should. The end of the nose, being formed of cartilage, is made up of small planes or facets which should be clearly indicated; and the ori-



DIAGRAM 77

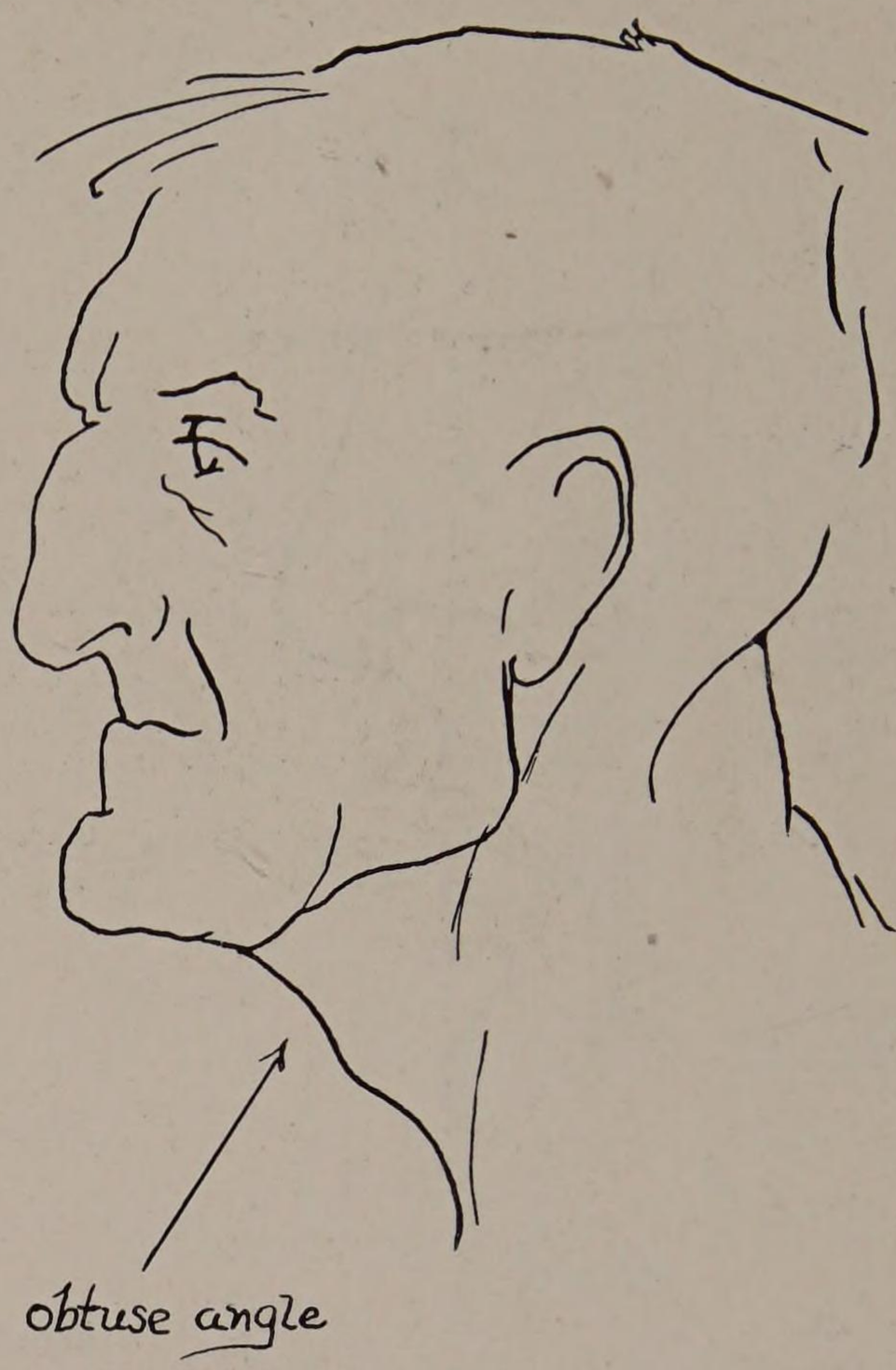
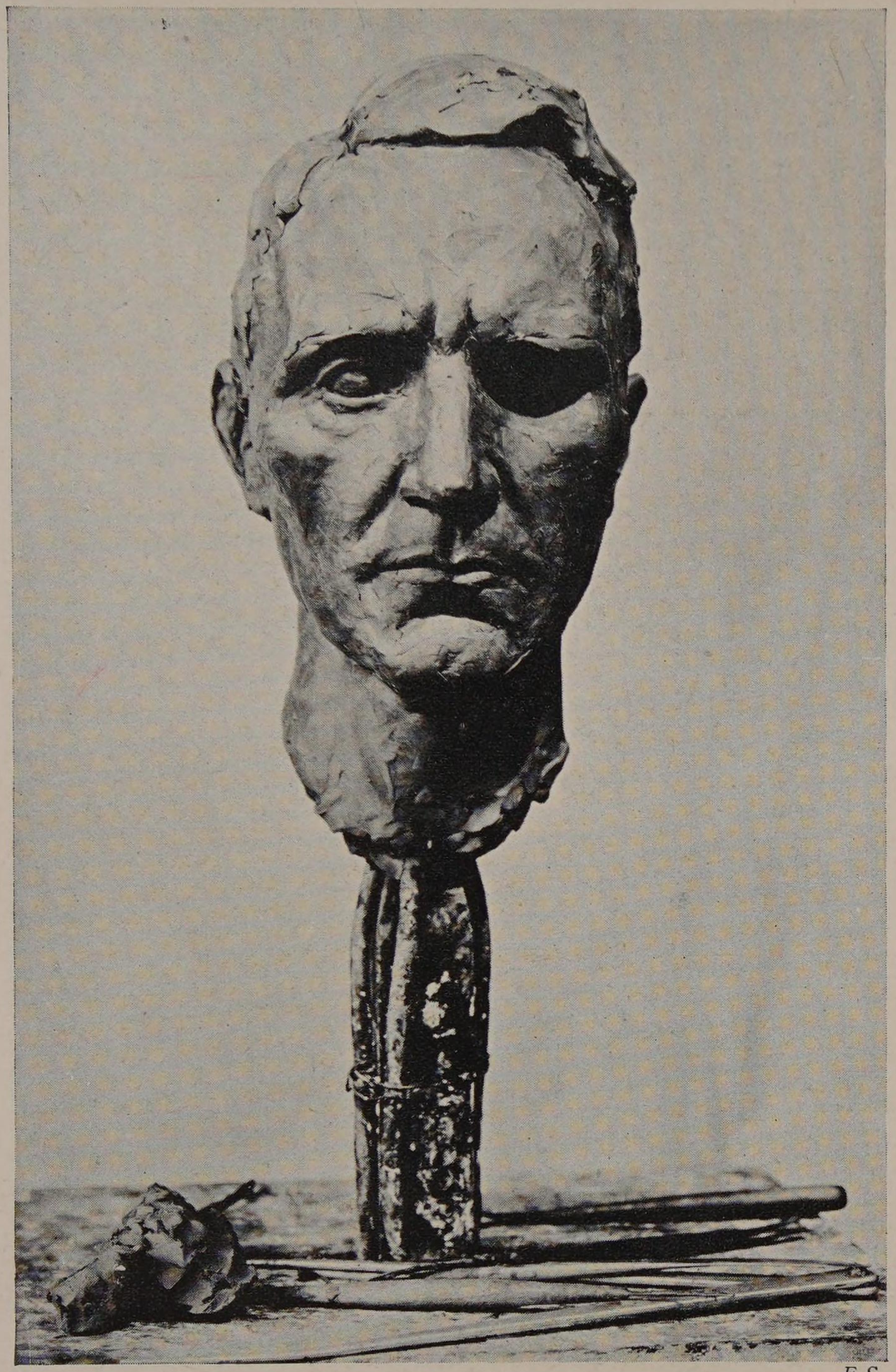


DIAGRAM 78

fices of the nostrils themselves are never round, as most beginners make them.

When working on the mouth, never for a moment think of it as a *line,* to be cut with a sharp tool. Remember that the lips are the upper and lower sections of a thick and flexible muscle, which contracts, expands and parts at will. The rounded forms *roll* together, and only by modelling up across the upper lip and down over the under lip can we suggest their rich form and mobility.

Under the chin is a part which deserves more attention than it usually receives. Consider for a moment the typical, gradual change in the line of jaw and throat from infancy to old age. In the child we have a curved, almost unbroken sweep *up* from the tip of the chin to a point just below the ear. In the old, that line points *downward.* Nothing so gives an effect of age as stringy, downward strokes of finger or tool at the throat. Model instead *upward* from chin to throat, and *around* throat and neck, if you would give an impression of youth (Diagrams 77 and 78).



E.S.

PLATE 119. A Later Stage, Showing One Eye Laid in Socket



E.S.

PLATE 120. A Later Stage, *Profile*

By this I do not mean that you should eliminate or "slick over" the lines of character in an older person's head. This would be sheer lying, and would result in a smooth, weak and meaningless piece of work. Model honestly what you see and feel. Only remember, when you dig creases in the brow or crow's feet at the corners of the eyes, that these are but slight details on the outer surface and that the skin, though slightly corrugated by these lines, is never actually broken by them. Remember, too, that cartilage and skin are semitransparent and absorb much light. If you incise the nostrils or ears of your opaque clay model to a literal depth, the holes will appear much too black.

But to continue with the demonstration as shown in Plate 119, note that not until all the major constructive work has been done do I give any attention to the eyes. If the sockets are properly constructed, eyes can await their turn. When it comes, the eyeball itself should be separately formed and laid in the socket. After that the lids are laid over the ball. Only thus will one be able to overcome the tendency to draw the eye on the surface of the face. All *eyeballs* are the same size—it is their setting which gives them individual character. As Charles Grafly once said to me: "Model *around* the eyes and the eyes will come of themselves." Never forget that the lids are not just skin, but muscle, with a very definite form and thickness. Study your sitter's eye in profile, and see how far the upper and lower lids project. If you copied the plaster eye shown in Chapter II, you will have acquired some understanding of its construction, and of the differences between inner and outer corners, etc.

Many of us have a tendency to place one eye lower than the other, or farther forward. A mirror is very helpful in checking such discrepancies. And different lighting effects are an absolute necessity. If you work entirely in an overhead light, you neglect the end of the nose, the modelling under the chin, etc. A side light, though not so pleasant nor so flattering to your work, is a much safer light to model a portrait in, for if it looks right in both side and absolutely flat front lighting, you may be sure it will look even better in an overhead light.

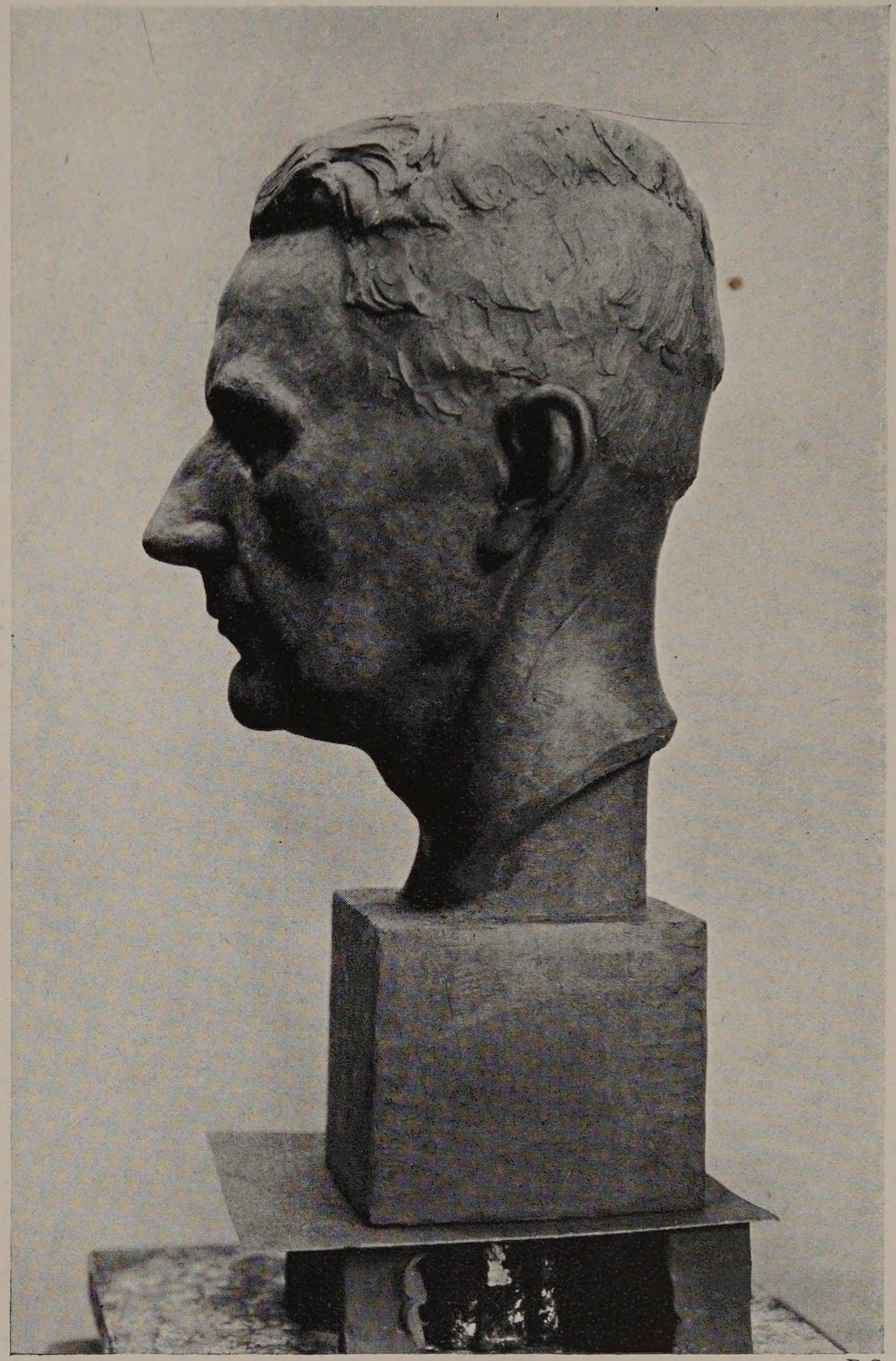
Light and shade are so vastly important to sculpture that a direct light from the front can have quite devastating effects on one's work. Compare Plate 121 of the finished bust, in an overhead light, with Plate 134, showing the same head illuminated from almost in front. Is it not difficult to believe that these two heads are identical?

Apparently even our museum directors fail to realize that in sculpture the *source* of light, the *direction* from which it comes, is all-important, especially for portraits.



E.S.

PLATE 121



E.S.

PLATE 122

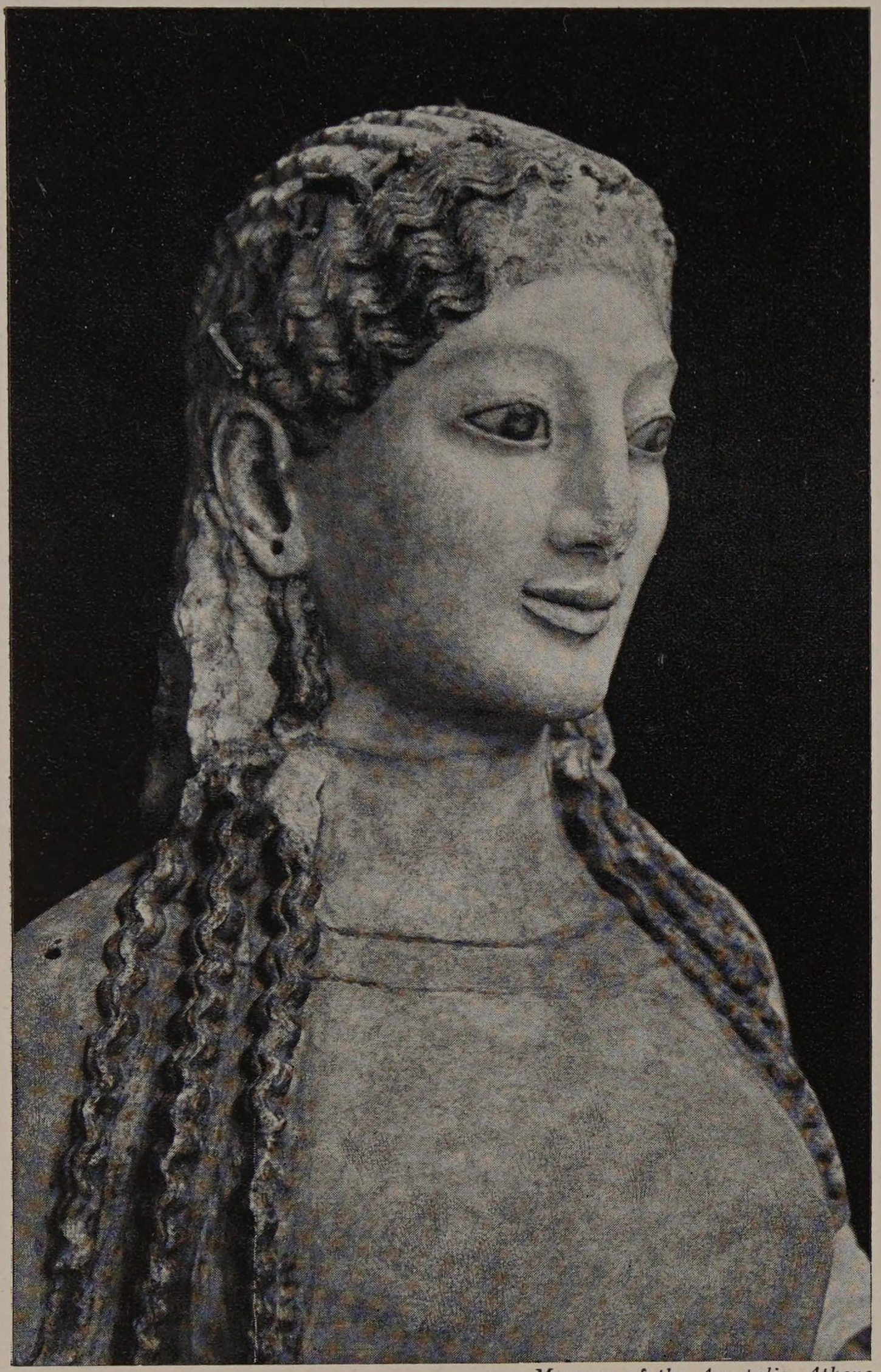
The Finished Head, with Base

In almost every museum are long dreary corridors, lighted from one side only, in which we find rows of perfectly characterless busts. Those facing the windows are blank white masks, while those between the windows are blank gray masks, and their apparent similarity is most depressing. When Daniel Chester French created his last great work, the Lincoln for the Lincoln Memorial in Washington, he was given to understand that the glass roof would cast an overhead light *down* on his statue, which he proceeded to model under a high skylight in his own studio. Alas! When the marble statue was finally set in place, the daylight pouring in and *up* on it through the columns of the open hall, proved so much stronger than the light filtering through the glass roof, that many of his effects were either wiped out, distorted or completely reversed. This is but one of the many unforeseen tragedies that can break a sculptor's heart.

THE INTERPRETATION OF EYES

Here is one of the most perplexing problems with which a sculptor has to deal. In most of the early Greek marble statues and busts, as we see them today, the eye is a blank, rounded orb. The form is there, but no slightest indication of color. Archaeologists say, however, that in most of these heads, as in the Egyptian portraits, the iris and the pupil, and even the lines of the eyelashes, were painted on, often giving a staring aspect to the eyes (Plate 123). In later Greek, and in most Roman, busts there is also a more or less successful attempt to indicate the pupils by incising the central portion of the eye: the iris is indicated by an outline, and the pupil bored in with a drill—a hard and mechanical process which usually fails to convey any sense of the translucent quality of the human eye. Sometimes, for bronze casts, they left a hole between the lids which, after casting, was filled with an ivory eye, inlaid with an ebony pupil! By now, the ivory eyes have fallen out, so in the bronzes of that period which we see today, the eyes are again mere empty holes.

During the Renaissance, further experiments toward naturalness were made with glazed terra cotta and painted wood (Plate 124), and the incised pupil was used more and more often. From then until our own time it has been the accepted practice. Possibly in certain types of head, in which a very dark eye is the most salient feature, incising will always be necessary to give a true impression of the sitter, but the resultant loss of form is always a pity. A healthy revulsion against too much realism in sculpture is today manifest everywhere and the deeply excavated eye is, I hope, rapidly disap-



Museum of the Acropolis, Athens

PLATE 123. Archaic Treatment of Eyes and Hair
(Detail of Figure from the Parthenon)

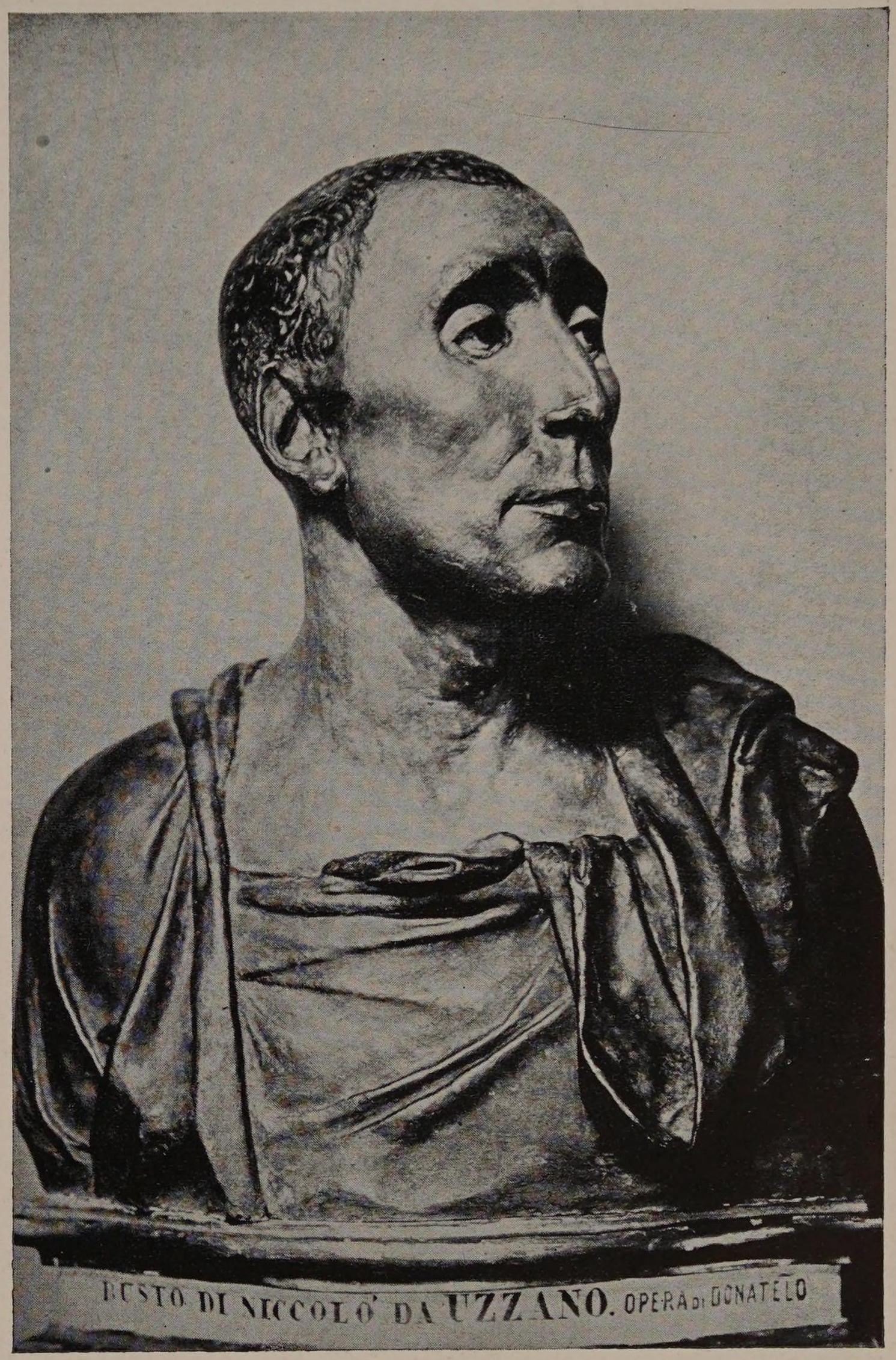


PLATE 124. "Niccolo da Uzzano," *Terracotta.* Donatello

pearing. After all, unless we resort to paint, we sculptors cannot truly depict the color of the hair or the lips, so why should we, by incising a rounded form, try to "color" the eye?

Not only does a deep hole give too abrupt a black shadow, but if the bust be shown in an unfavorable light, the whole effect may be exactly the reverse of what the sculptor intended.

Far better to concentrate on the form of the eyeball, just as we should treat the hair "en masse" and not as individual strands of a particular color. After the ball has been carefully modelled, plenty of suggestion of pupil may be given by a most delicately traced outline. But as you will see by the various heads shown at the end of this chapter, even this is quite unnecessary.

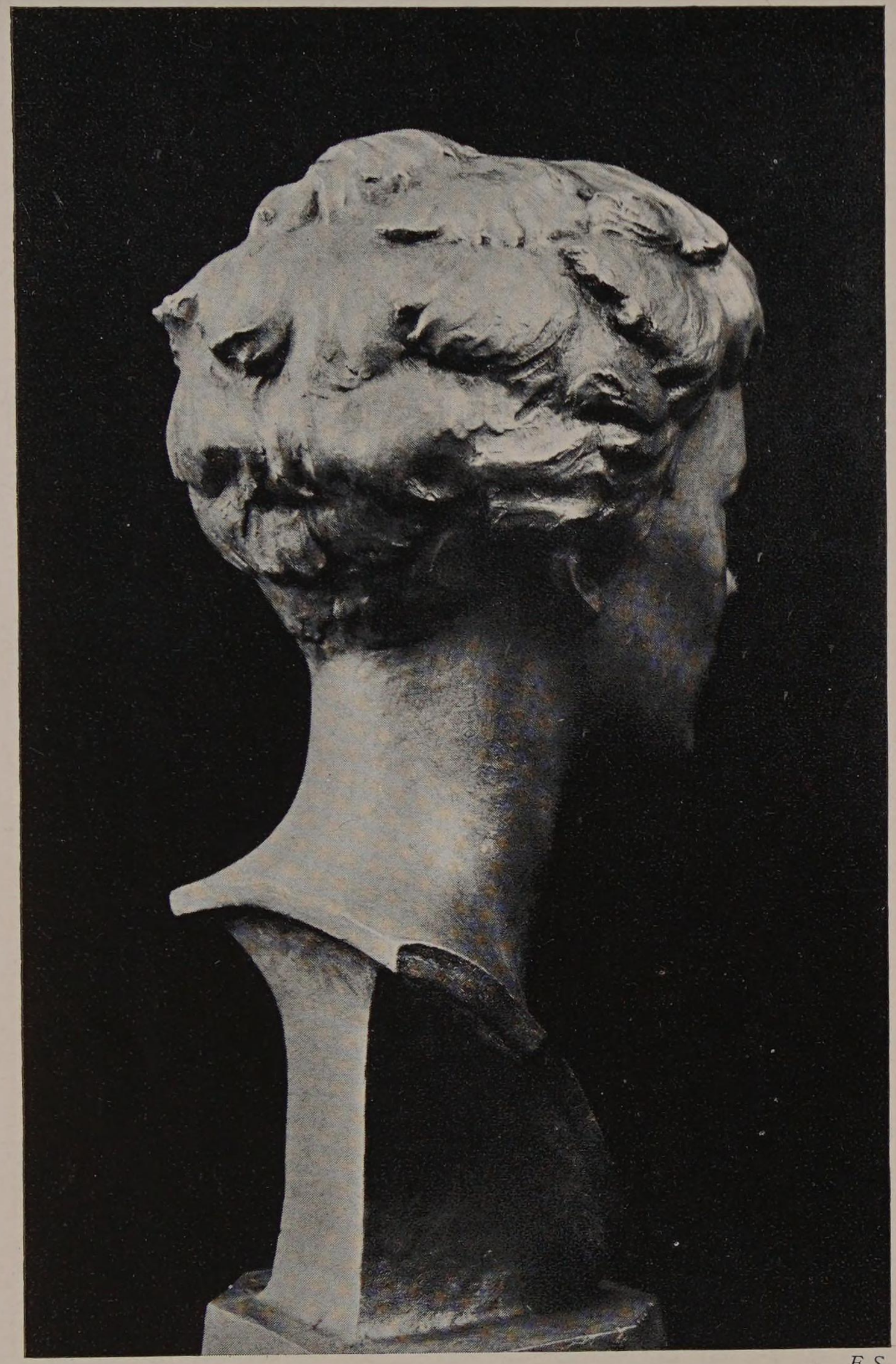
THE TREATMENT OF HAIR

There are few parts of the sculptured figure the interpretation of which has been so strongly influenced by present-day reversion to an archaic style as the hair. We see all about us a growing tendency to treat hair in a conventionalized and decorative way. The sculptor, having reduced his figure to terms of the utmost simplification, crowns it with a carefully studied ornament, indicating the strands of hair by parallel curved or zigzag lines. While this seems altogether fitting in a symbolic figure, it is not always a happy solution when it comes to portraiture. It is too apt to give the effect of an artificially produced "wave." Especially is it to be deplored when the modelling of the features themselves is more or less literal. Two styles in the same piece simply will not do.

How ridiculous, for instance, would archaic-looking hair be on a head such as is used for demonstration in this chapter!

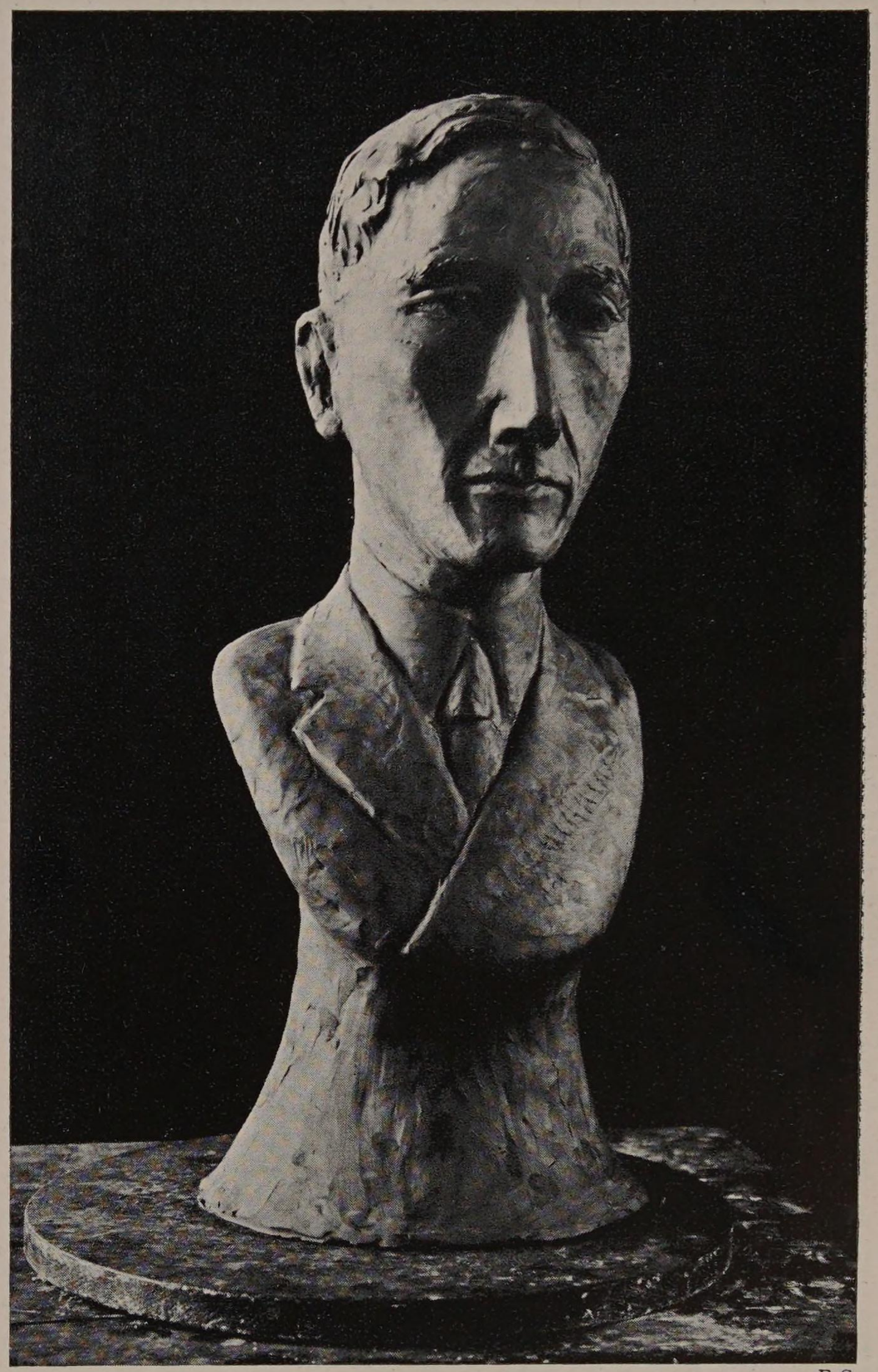
But there are always design and pattern, even in the close-cropped hair of the average businessman, and it is for us to find it. Hair grows in certain definite masses and directions. Study the back of your sitter's head and you will certainly find a point whence all the hair radiates. There is bound to be some interesting form here, as well as at the nape of the neck.

When hair is long enough to have definite, shadow-forming undercuts, these also may be made to contribute to the design; but beware of making them too deep, or ever at a point where the hair grows from the scalp, for at such points hair and skin must



E.S.

PLATE 125. Head of Amelia Earhart, *Rear View.*
Brenda Putnam



E.S.

PLATE 126. What *Not* to Do

subtly merge, or the former will resemble a wig. Hair, when short, usually grows from the top of the head in layers, the upper layers overlapping the lower like shingles on a roof. In Amelia Earhart I found this so distinctive a characteristic that I used these layers to make a definite pattern (Plate 125).

Remember that light, shining on hair, lends a sheen that can only be rendered by a perfectly simple, smooth surface. At such salient points there should never be any scratches of the tool. Reserve these for the ends of the strands and edges of the various forms, and at all times use them sparingly, for hair scratched in "hit or miss" all over will never give any suggestion of the real thing.

THE TREATMENT OF THE BASE

"What shall I do with the base? How shall I finish it off?" cries the perplexed student.

Simplicity and good taste are the prime requisites for a satisfactory solution of this problem. For a head such as I used for this demonstration, I felt that a substantial, unpretentious block was the best solution. For a complete bust, with drapery and shoulders, the well-designed plinth in Donatello's bust (Plate 124) is as satisfactory as any, for it is unobtrusive, yet sturdy enough to carry the full weight. Gone forever we hope, are the days when shoulders flaring with elaborate drapery were insecurely perched on minute spools of marble or bronze! A base must certainly be large enough to support what is above. And it should certainly never be made like the one in Plate 126—a horrible example for us all of what not to do in a bust! Not only is the shape of this base utterly unstructural and meaningless, but it is also highly impractical for, cast in fragile plaster, the thin lower edge will break off in bits every time the cast is lifted and set down on a hard surface.

It is always possible, of course, to leave the base a rough mass of clay, giving a spontaneous and unlabored effect as though the head had been evoked, as it were, from a lump of inanimate matter. Quick, freely handled character sketches are perhaps best presented in this way; but if you prefer to use the block, make sure that this is geometrically sound, not a wabbly, freehand pudding. Get a spirit level and a right angle, and true it up. First make sure that the top of your stand is level, then level the block itself. You will be astonished to find how untrustworthy the eye is in such matters. Every surface, every edge, and every two surfaces should be trued up by using the right angle

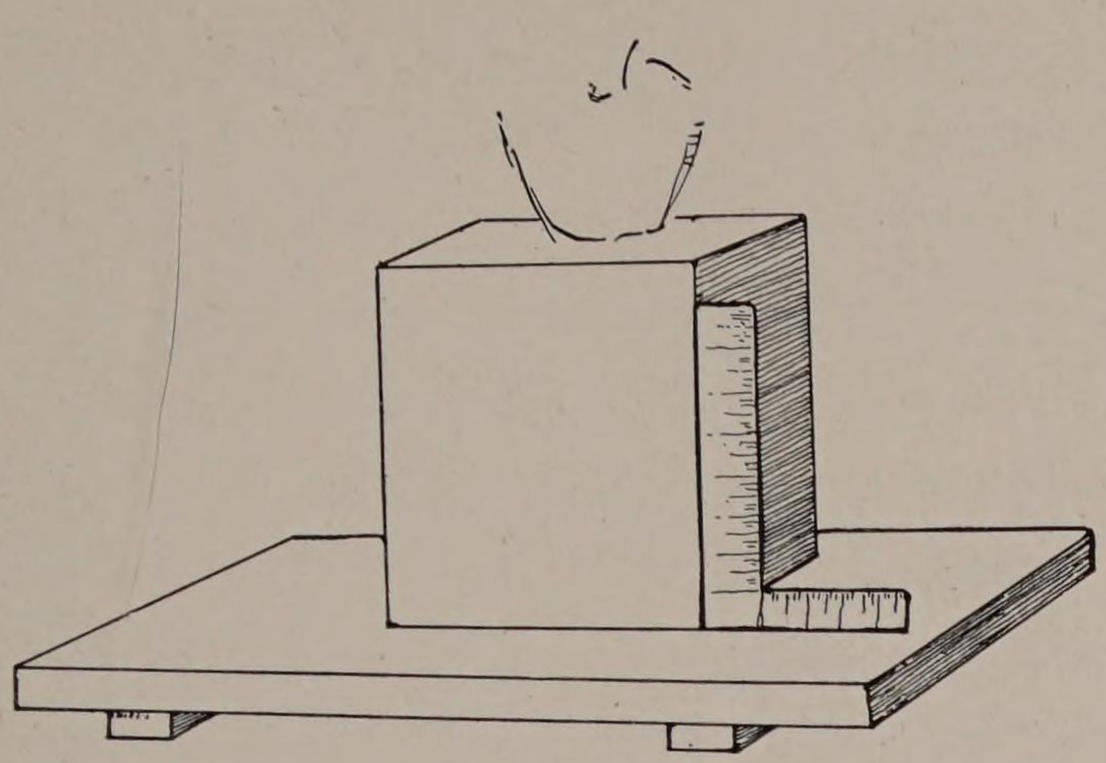


DIAGRAM 79

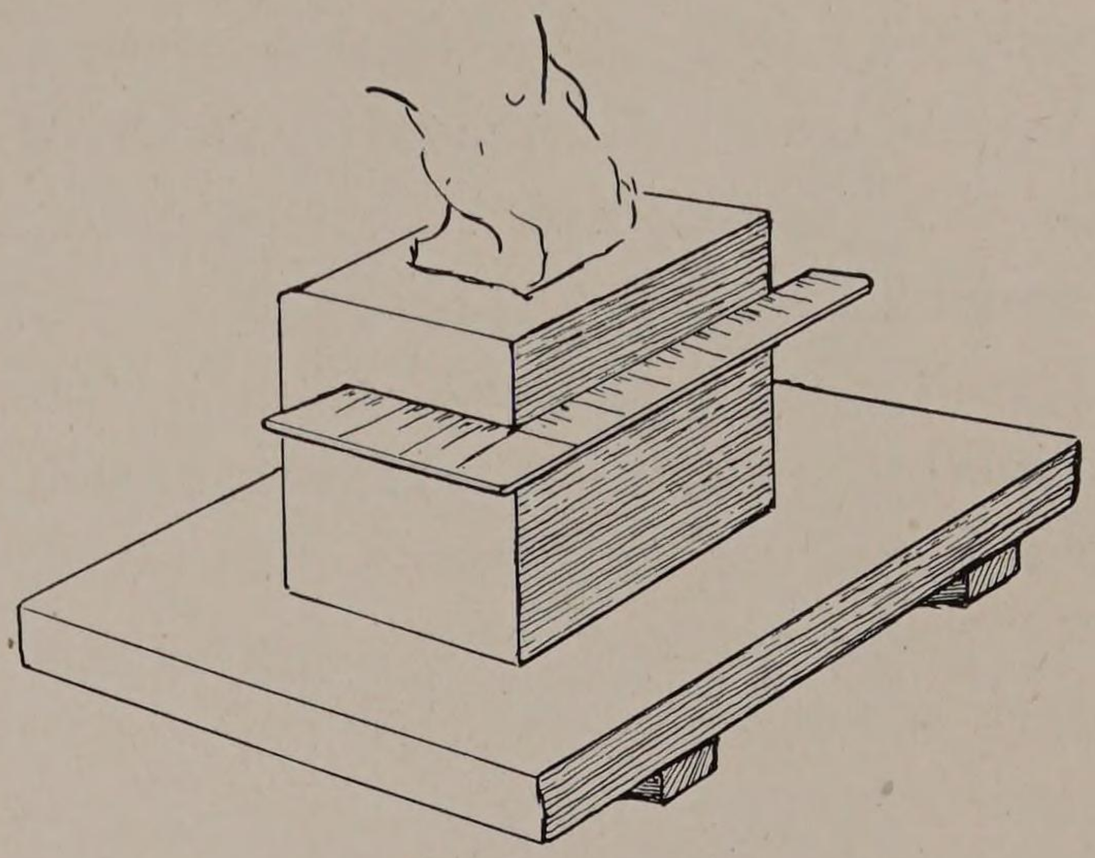


DIAGRAM 80

as indicated in Diagrams 79 and 80. Enough of the block should lie forward under the face of your head so that the beholder will have no uneasy feeling that it may topple forward.

CLOTHES

If you are obliged, as many of us are, to do a bust of a man in present-day clothes, let me add a word of caution here. When you make those clothes—*make* them. Model them with conviction and sincerity, showing that they are heavy and separate materials superimposed on living shoulders. If you attempt to distract attention from them by slicking them down to a colorless flatness, the result may be as unfortunate as that in Plate 126. The poor man's collar and coat seem to be glued on! Far better to model the clothes freely and loosely. The curve of a lapel, especially if the coat be unbuttoned, *can* be made quite a handsome thing, and definitely sculptural.

PORTRAITS FROM PHOTOGRAPHS

Only those who have had long and varied experience in doing portraits from life should ever attempt the heartbreaking task of evolving a bust from photographs only. Yet countless inexperienced students find themselves faced with the temptation to do this. It may be some well-known personage whom they have never met, or it may be the deceased relative of some friend who can give only a general description, a few bad snapshots, or a single large professional photograph from which every trace of modelling has been retouched. Even though there be many photographs, you may be

sure that *none* will give a view of the *back* or three-quarters backview of the head. Yet these are vitally essential for sound construction.

The student who undertakes such work, though he may achieve a superficial resemblance as to eyes, nose and mouth, is practically doomed to failure at the start. Even if the thing be accepted by those who know nothing about sculpture, the sculptor should, as an artist, be too honest to give out shoddy work which only tends to lower still further the low standards of art among the general public.

Sometimes an aspiring young sculptor will be vouchsafed one, just one, sitting from some eminent person. Unless the young artist has a truly phenomenal talent and can make a brilliant small clay sketch in a single hour, my advice to him is this: Ask the great man to meet you, not at your studio but at a photographer's. In about half an hour, or less, the photographer, under your direction, will take about eight views of your sitter's head, turning him after each exposure so that the head is photographed from *every* point of view, including, and especially, the back and three-quarter back. Have his head clearly defined against a black or white background, with sufficient overhead light to clearly define the bony construction of the skull and face.

Then make the photographer swear that he will do no retouching whatever on the plates. Unless you take this precaution, he will get busy with his little brush the minute the plates are dry and delete every trace of line and modelling between the features. And this modelling is, next to the structure of the head, what you need most, for the features themselves are probably familiar to you. It is what happens *between* them that will require careful study.

While the photographer is working, you, too, will be at work, either with quick pencil sketches, or simply looking and impressing important points on your memory. And if there is time, a few measurements may be taken which will serve to check your modelling later on.

A single sitting, so planned, will secure enough material to keep you busy for many days and enable you to make a searching study of the man. Whereas if you had used all the time in building up the preliminary foundation for a full-size head, your sitter would walk away leaving you stranded with a portrait barely begun and no chance of completing the work.

The final illustrations in this chapter are photographs of portraits done by great artists of various periods.

Although the head in Plate 127 was carved out of unyielding granite, thousands of



Courtesy Metropolitan Museum of Art

PLATE 127. Egyptian Head, *Diorite*



PLATE 128. "Portrait of a Young Sculptor," *Plaster*. Libero Andreotti



PLATE 130. Head of a Child.
Charles Despiau



PLATE 129. Theodore Roosevelt.
James Earle Fraser

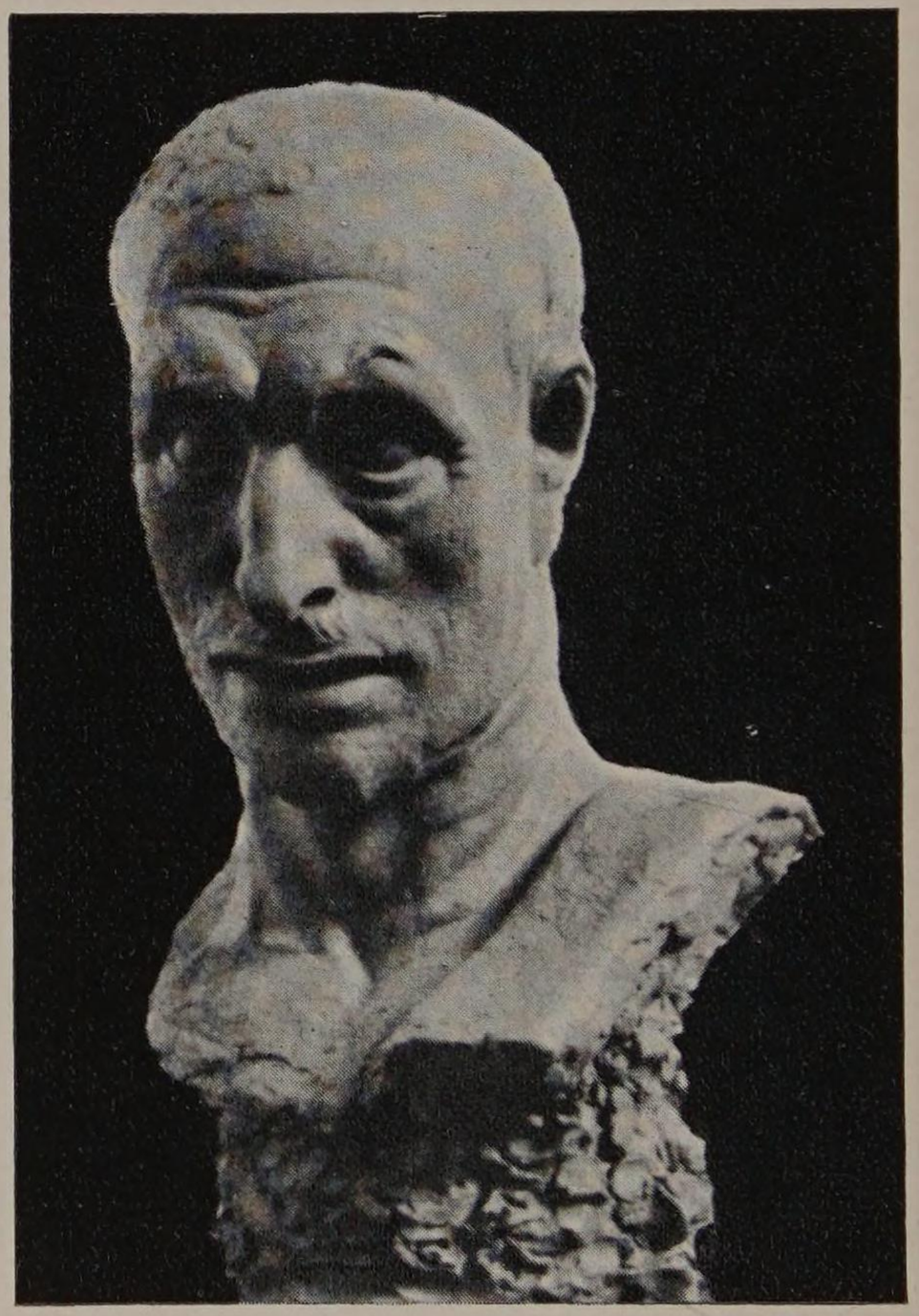


PLATE 131. Copy of Donatello's "Zuccone." Brenda Putnam

years ago, and the one in Plate 128 was modelled in soft clay in a single morning, a dozen years ago, the two sculptors were spiritual brothers, with the same sense of the dignity and beauty of the human head. I had the rare privilege of watching the portrait in Plate 128 grow from a mere lump of clay to a speaking likeness of the youth, all in less than two hours of work. And what superb structure is indicated in the boy's head! Notice how the bones are felt through the skin—how free and vivid is the modelling. Not a single unnecessary stroke of finger or tool—all is reduced to terms as simple as though this sculptor, too, had been carving in granite.

Fraser's vivid portrait of "T. R." (Plate 129) is also full of power, but dynamic rather than static in conception, with its characteristic thrust of neck and jaw, and rich, free, sensitive modelling of both flesh forms and clothing.

Another extremely sensitive and perceptive portrait sculptor is Charles Despiau, whose lovely head of a child is shown in Plate 130. The student will do well to study with particular care the way in which this sculptor has placed and modelled the eyes of his grave young sitter.

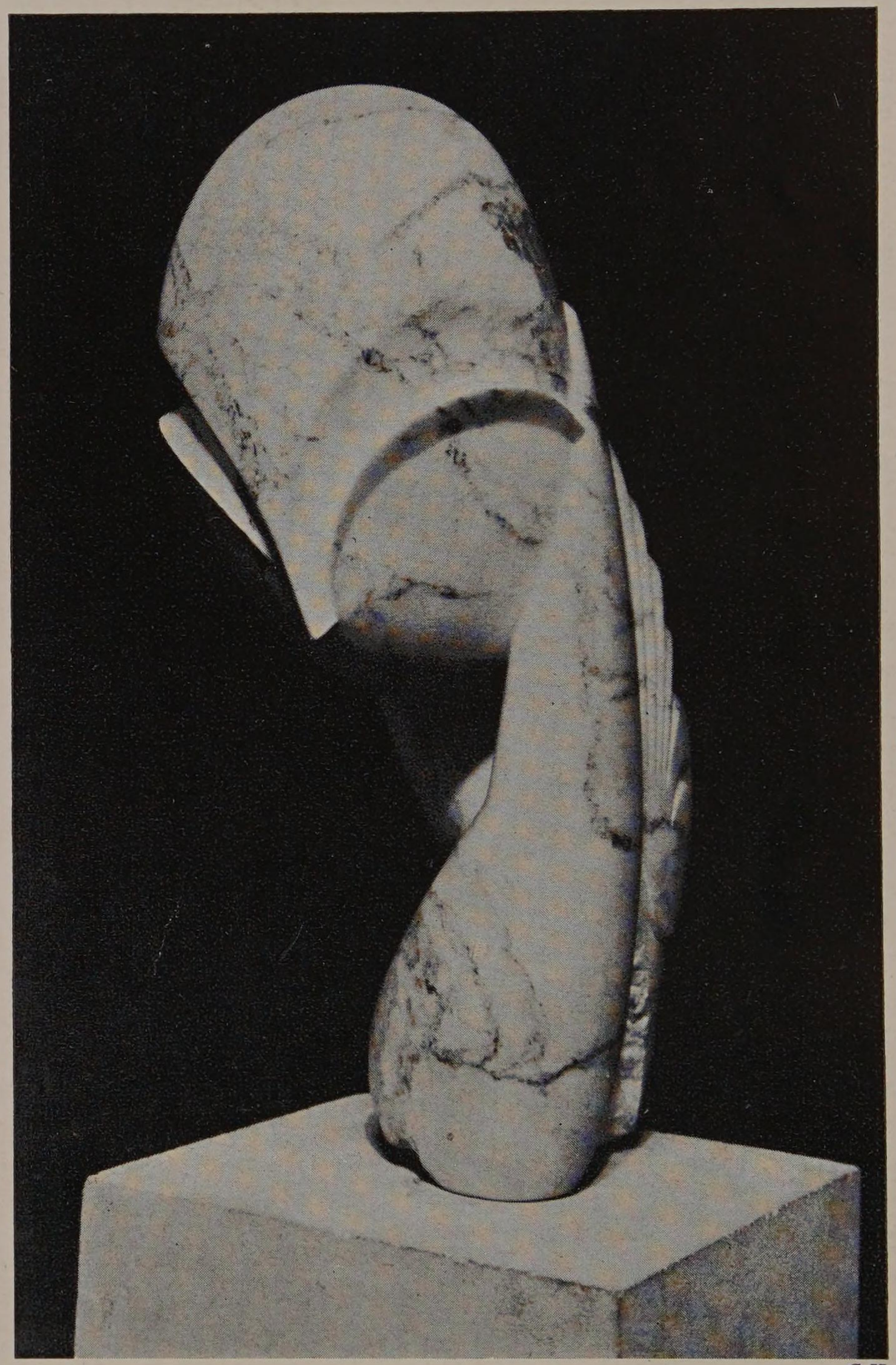
I have tried in vain in this country to get a plaster cast of the remarkable "Zuccone" head by Donatello. Failing this, all I can show you is a photograph of my own copy of it, modelled in Andreotti's class in Florence (Plate 131). The head must be seen from all viewpoints to be thoroughly appreciated. With its remarkable brow formation, its deep-set, tragic eyes and suffering mouth, it is undoubtedly one of the most interesting and vital portraits ever made. Unfortunately, the figure of which it is a part stands in a niche high up on Giotto's tower, cruelly exposed to the elements, which have so streaked and battered it that the face is now partially obliterated, and a photograph of it shows hardly more than a series of black smears.

Lastly, to bring us fairly up to date, we have two versions of a portrait of Mlle. Pogany, by the French sculptor Brancusi, whose "Bird in Flight" may be familiar to some of you. Plate 132 gives the head as it was first shown in this country, at the astounding Armory show of 1913. By some ribald visitors it was nicknamed "The Mislaid Egg," and the public had a gay time making fun of it. To me, it suggested a magnified head of an immature insect, with its enormous eyes and minute mouth tucked away down under. But however we felt about it, it did succeed in making us *think*. I found myself wishing that the sculptor, having gone so far along the road toward abstraction, had continued in this vein until all suggestion of features had been eliminated. It was, therefore, quite a delightful surprise to see, years later, another version of Mlle. Pogany



C.K.

PLATE 132



C.K.

"Mlle. Pogany," *Marble*. Constantin Brancusi

PLATE 133

(Plate 133), in which the sculptor had done just this, and created a composition of interesting forms. *This* has real beauty—a beauty that is derived solely from the curious pattern, enhanced by the veined marble in which it is carved. No longer distracted by features which "aren't right," the beholder is free to derive infinite pleasure from the rhythms of the design itself.

CASTING A PORTRAIT HEAD

Materials Needed:

½ bag finest casting plaster (35 to 50 lbs.).
3 pails.
Large and small flexible copper mixing bowls.
Large kitchen spoon.
Liquid blueing.
Olive oil.
½ pt. soft soap boiled (1 part soap, 2 parts water).
1 burlap potato sack.
½ dozen thin irons (about ⅜ inches thick).
1 scraper.
2 chisels.
1 hammer.
Plaster tools.
Several brushes.
1 doz. newspapers.
Tissue paper.

As plaster casting is one of the messiest jobs in the world, it is well, unless you have a regular studio where you can make a mess, to do this work in some part of the house where there are no rugs or good furniture, where spatters of plaster on floor and walls will not matter, and, if possible, in a room where there is running water.

First spread newspapers, several sheets thick, over a wide working area on the floor and in a path to the sink. Also lay some papers over the top and sides of your modelling stand to catch the worst of the spatters. Fill two pails with clean, cold water. The third will be used as a slop bucket. Place the modelling stand in a good, strong light on the island of newspapers. Near it set a small table, also covered with paper, on which place in readiness the copper bowls, blueing, soap, oil, brushes, scraper, spatulas, chisels, irons, etc. On the floor near by, set the bag of plaster and the pails. Cut half of the potato

sack into strips varying from 6 to 12 inches long and about 2 inches wide. Swab a little grease or oil on the mixing bowls and the spoon.

Casting a head in the round is, of course, much more complicated than casting a relief (see Chapter IV). Obviously, if we make the mold in one solid mass there will be no way of getting it off, once it is hard, without breaking it. Therefore the mold of a head is always cast in two (or sometimes more) sections—one section, the back, being somewhat smaller and so made that it will pull off the head without difficulty. Once we have that section off, it is a simple matter to dig the clay and armature out from the front half, which contains most of the undercutting, without damaging the mold; though, of course, the clay model is thereby destroyed. Your first consideration is, then, to decide where you will divide the front and back sections of the mold. Some prefer to make the seam come back of the ears. Others place it just in front of them. I prefer the latter method and used it in the demonstration illustrated. The first method eliminates from the front views of the finished cast any trace of the seam, which usually does show a trifle. Also it insures an easier removal of the back section with no clay to catch in the ears. On the other hand, if the ears are included in the front section of the mold, they are extremely difficult to get at and to clean thoroughly when the mold is to be washed. Clay can sometimes be syringed out, but plasteline is apt to stick in hidden crannies and we don't know until our cast emerges from the mold that half the ear is still plasteline and must be remodelled in the plaster—a difficult business.

Plate 122, showing the head about to be cast, shows also how a base has been used which is fairly simple to cast. Note that between the back of the neck and the base, I have left a strong support. The reason for this will be understood later on. While modelling, I had left space between my head and the board to carry out shoulders, or a much deeper base, but finding both unnecessary, have simply stopped in mid-air, propping a square of cardboard under the clay base to catch the plaster and define the bottom edge of the mold.

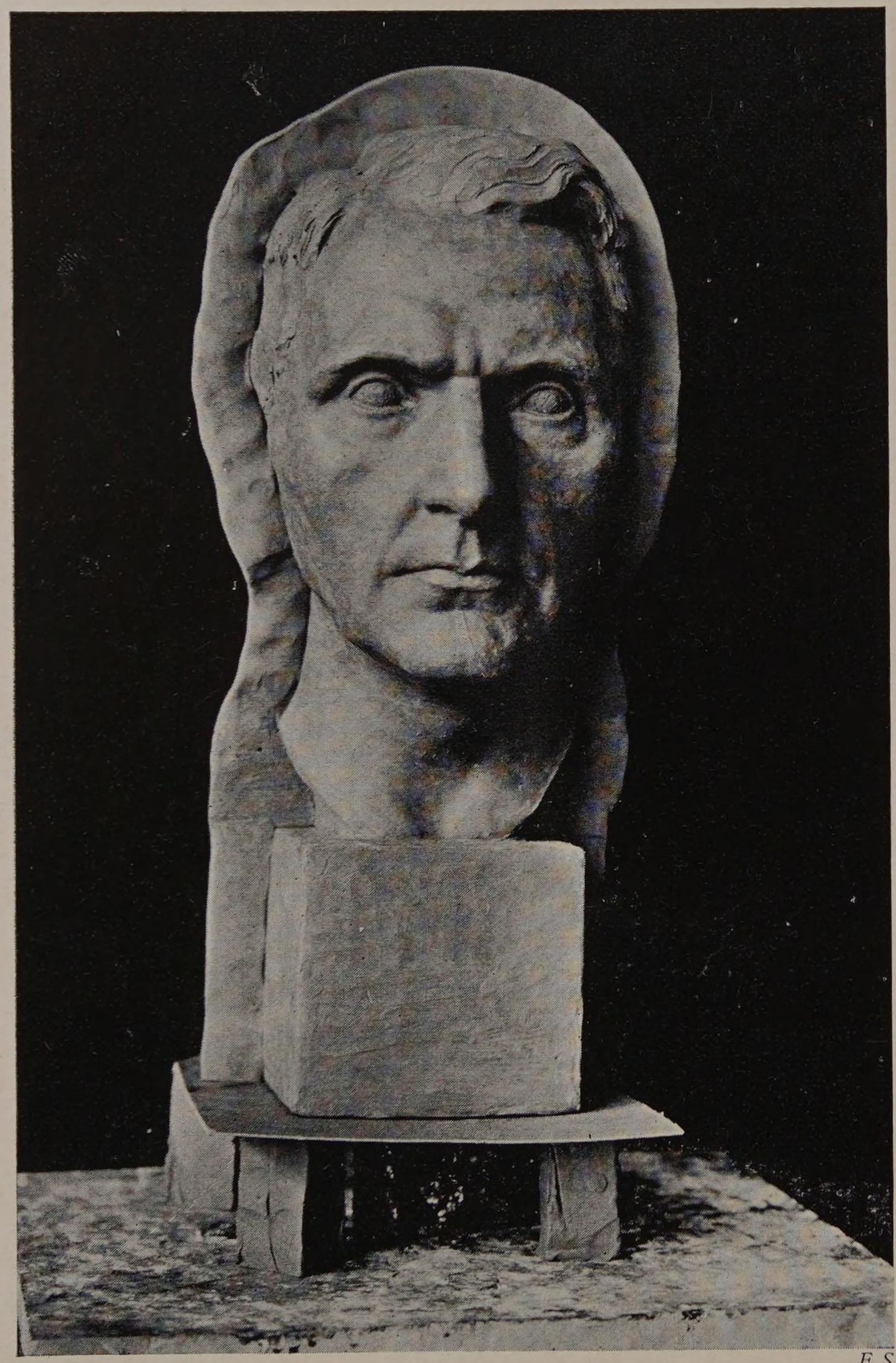
The Clay Wall—Now take some clay, roll it on a flat surface pressing as you roll, until it is a cylinder about 8 inches in length and 1 inch thick. With your left hand, raise one end and, beginning at the other end, with the side of your right hand, hammer this cylinder out into a flat strip, until it is 2½ inches wide and ¼ inch thick. Make enough of these strips to extend from the bottom of the base up along the neck, up

over the top of the head and down the other side. With a blunt tool trace very delicately on the head the line which the clay wall is to follow. Then lay the strips edgewise along this line, pressing them as close to the form as possible without blurring the modelling. There should be no spaces between the wall and the head, otherwise plaster may seep through to the other side. With a spatula and bits of extra clay, clean up the joints of this clay wall and *at the back* brace it with a few bits of clay lightly stuck on to hold it upright. Plate 134 shows the clay wall in position.

Shims—Many casters today have discarded the clay wall in favor of shims—small strips of thin brass cut into bits about 2 inches long and 1 inch wide. With these, the caster makes a similar halo about the head, but, instead of removing it when the front half is done, he leaves the shims in place to act as a paper-thin partition between the two halves. It takes considerable skill to build the partition with these bits of metal without damaging the model, and such metal ("shim brass") is not always obtainable outside of large cities, so the clay wall is used in this book as being, on the whole, the safest method for the beginner.

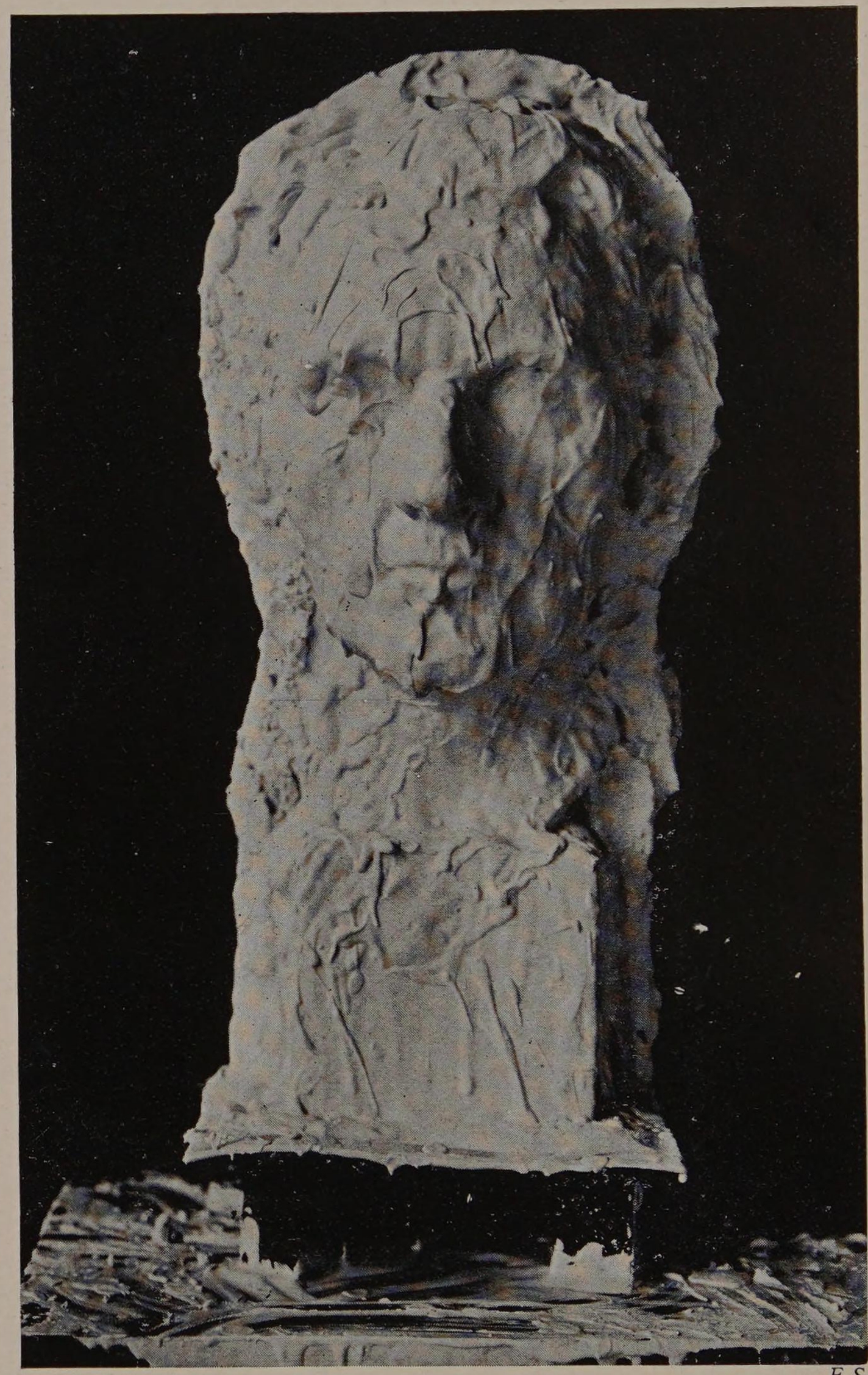
Before mixing plaster, it would be well now to spray, with a fixative blower, a thin film of water over your bust. This will blend with the liquid plaster and help to prevent air bubbles in the mold.

Next, to protect the back of the head from splashes of plaster while the front part of the mold is being made, moisten some sheets of tissue paper and lay them over the back of the head. The plaster is now to be gauged. The first layer of plaster is the crucial one and must be mixed with care as well as speed. This first layer should be of a different color from the outer layer, in order that, when chipping the mold away from the plaster cast, we may readily note when we are approaching the cast itself and, consequently, be more cautious. This color is obtained by pouring into the water of the large mixing bowl two tablespoonfuls of blueing. Into this blue water sift the plaster quickly and carefully, discarding any small lumps of plaster which do not immediately yield to the mixture. Fill the water with plaster, up even with the surface, but no more, or it will be too thick. Then with the spoon, stir without lifting the spoon out of the mixture. A few bubbles, or scum, will rise and they must be skimmed off. Now, using the smaller mixing bowl to dip out a portion of the plaster, which should be pale blue and like thick cream in consistency, begin flicking the plaster onto the front half of the clay



E.S.

PLATE 134. Head with Clay Wall, Ready for Casting



E.S.

PLATE 135. The First Layer of Plaster Applied

head, or dabbing it on with a very soft clean brush. Blow it vigorously into such deep parts as eyes, nostrils, etc. Much of the plaster will run off. Catch it as it comes and continue to throw it back until a thin coating is secured over the whole front section. Be sure you get under the chin and nose, for at first the plaster will run away from those parts and will need to be coaxed under. When you are sure that every bit of the surface is covered (but not too thickly—about ¼ inch is sufficient), get more plaster from the large bowl and make a thick wall of the blue just in front of the clay wall. This seam is a most important part and needs to be stronger than any other part of the mold. By this time the plaster will be setting and will more easily adhere to the wall. Scrape it clean along the edge with a scraper or spatula.

Plate 135 shows the head with the first layer of plaster applied.

If any plaster is now left in the bowl, scrape it out into the slop pail. It is better to waste a little than not to mix enough in the first place. If it sticks to the bowl in spite of the grease you put on, bend the edges of the bowl and crush slightly between the hands and the plaster will then come out.

Before you mix the second coat, take two irons and bend them so that they roughly follow the shape of the bust, one on either side. These irons, when attached, will not only strengthen your mold, especially at its weakest point, the neck, but will serve as convenient handles later in pulling the two sections apart. Do not attach them yet, but lay them aside. If the coat of blue plaster is now hard enough to touch without smearing the surface, mix a little clay water, or, if you have no clay, olive oil will serve, and with a brush lightly dab the thin mud, or oil, over the blue plaster. This will keep the two layers more or less free from each other and make them easier to chip off later on.

Now mix the second coat of plaster, this time without the blueing. This second mixture can be a trifle thicker than the first. Apply this over the blue, making the whole shell an inch or more thick. Now take the irons and bind them to the surface with a few strips of burlap well sopped in plaster. In Plate 136 you will see that I have left an expanse of iron free at the two sides at the neck level, to make convenient handles. A third iron is sometimes used across the base and also one straight up the middle over the nose, if the mold is to be shipped away to a caster, or if for some other reason it should be made extra strong. But if the job is to be put through all at once, two irons will be sufficient.

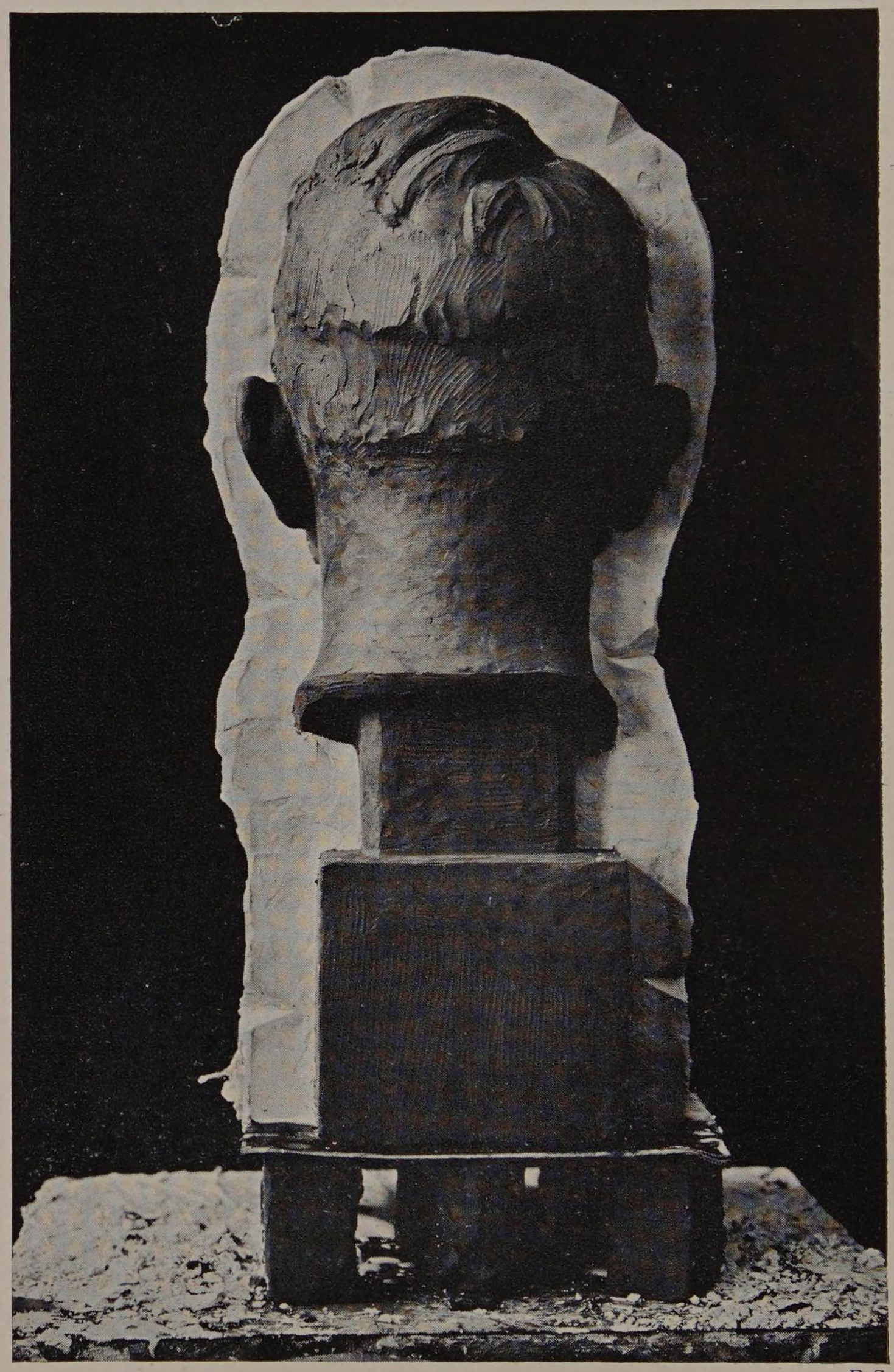
Clean out your bowls again and grease them.

Turn the bust around, remove the tissue paper from the back and then peel off the



E.S.

PLATE 136. Front of Mold Strengthened with Irons



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PLATE 137. Rear View with Clay Wall Removed

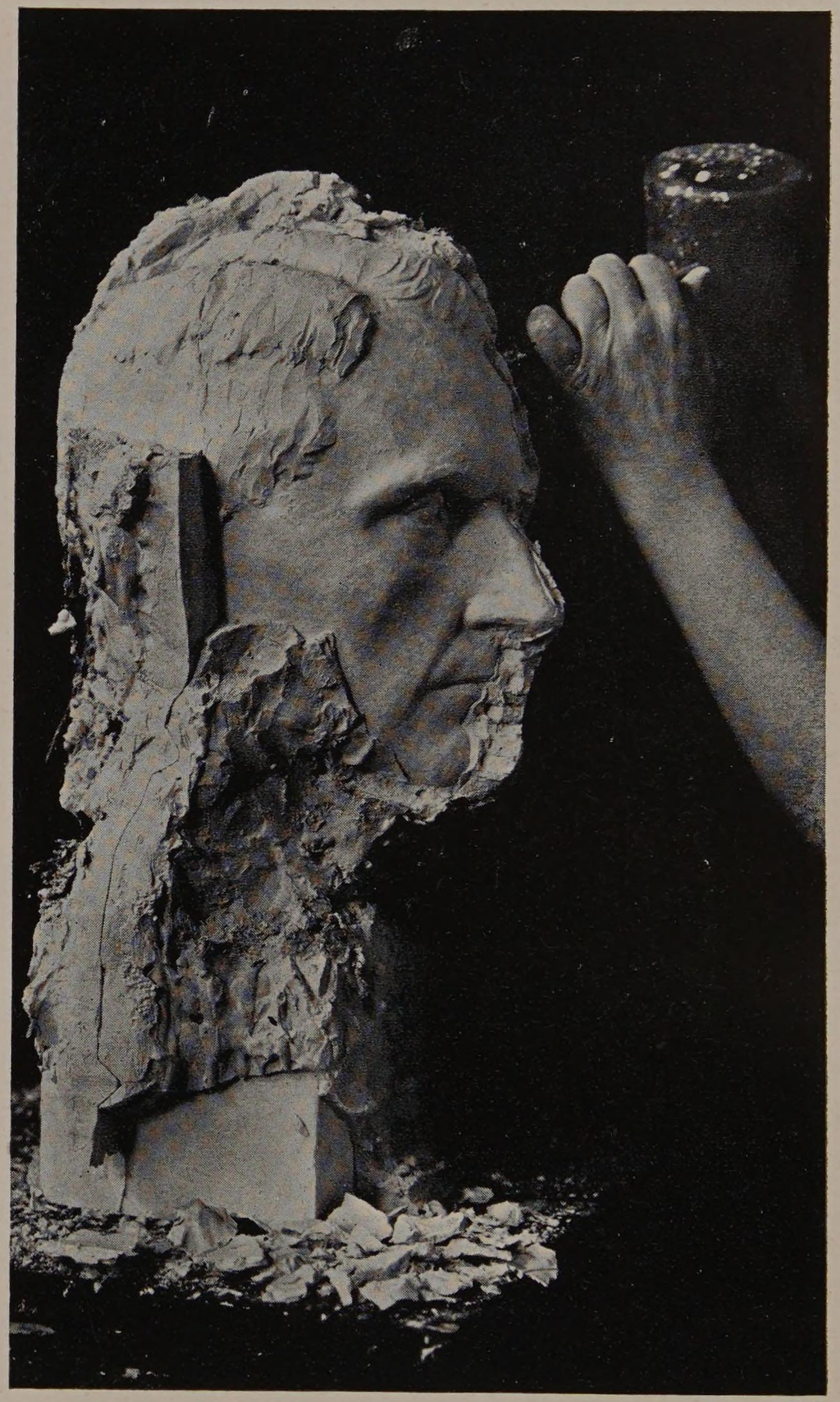
clay wall. This exposes a fine, smooth plaster surface about an inch and a half wide around your bust (Plate 137). With a sharp knife cut several V-shaped notches in the edge of this, to serve as keys when later you fit the two empty shells together. With a little soap, or oil, grease this exposed rim carefully. (If soap is used remove every trace of it after a few moments.) Then put blueing in the water and repeat, molding the back of the bust just as you did the front. Use two more irons for this back section, binding them on with burlap. Be careful that no plaster or burlap covers the seam, which must always be kept clear. As the neck is the weakest part of the mold and considerable strain is exerted on it when you separate the two sections, it would be well to add across the center of the rear mold, as well as around the base, either another small iron or a strip or two of burlap. About twenty minutes should elapse to allow the plaster to set thoroughly before you begin to pry the two sections apart. An experienced caster uses this time for cleaning up and preparing a clean box or other receptacle for the reception of the clay as he digs it out of the mold.

Now feel of your mold. If it is slightly warm, you may know that it is setting properly. Insert a thin chisel at the base of the seam at one side. Do not drive it far in and be careful not to drive it into one of the V-shaped keys. Then insert it into the seam at the other side of the head, easing it with gentle pressure forward and backward. Give the top of the head a few taps with the hammer. Soon a small threadlike crack will be discovered running down the seam. Pour a trickle of water over the seam at the top of the head. This will help to separate clay and plaster. When the opening crack is definitely established, stand behind the bust, inserting a blade on either side at the same time. Gentle but firm pressure will gradually force the back of the mold toward you, away from the front, and soon you may drop the blades and lift it away with your hands. If the seam has been made in front of the ear, you will find that clay has stuck in the ears but can easily be removed later. Lay this part of the mold to one side. Now tear off all the plaster-spattered newspaper on your stand, leaving a clean surface; rinse all plaster from your hands and, taking a large blunt modelling tool, begin to dig out the clay from the front half of the mold. Keep the clay as clean as possible, for there are few things more annoying than finding bits of plaster imbedded in the clay when you next start to use it. As the clay is dug out scrape it clean and toss it into the box or bin which you have ready for it. Soon you will reach the armature. When you have carved the clay from around it, the lead wire can easily be pulled backward out of the mold. Be careful to hold the front of the mold while doing this, or the whole thing may sud-



E.S.

PLATE 138. Rear Mold Removed, Clay and Armature Still in Front Mold



E.S.

PLATE 139. Chipping the Mold from the Cast

denly come away and fall to the floor. It will probably come away with considerable clay sticking to it. Lay it flat and remove the last bits of clay very carefully, piece by piece, being sure not to let your tool scrape the inner surface of the mold. Plate 138 shows the back of the mold standing free and clear while the front still contains the armature and rest of the clay. (Note the keys on the edge of the back section.)

If the bust was modelled in clay, it will be quite easy to wash out all remaining bits of clay with water; but do this gently, remembering that your plaster is still quite soft and could be blurred even by strong water pressure. If running water is available, let it run over the *outside* of the mold and the clay will soon be moist enough to come away. If the bust was modelled in plasteline, water alone may not suffice to remove every trace of it. You will find that where a piece of plasteline has become wedged into a crevice, another piece of plasteline dabbed at it may pull it free. But if all else fails, take a soft brush and a little benzine and dissolve the plasteline. Do not let the benzine remain long in contact with the plaster, but remove carefully.

Now that the two sides of the mold are clean, they must be soaped; either with shampooing liquid or soft soap which has been boiled in twice as much water. Pour some into each section of the mold and with a clean, soft brush work it over every inch of the surface for at least ten minutes. It will lather somewhat in the doing. Tip the molds this way and that to be sure that every bit of the surface receives its share, and work it well into the ears and other hollows. Allow to stand for fifteen minutes or until the plaster has absorbed all that it can. Now remove the soap. To do this do not use water. With your brush pick up as much soap as possible from the mold, then squeeze the soap out of the brush into the slop pail. Soap which has been used has been killed and cannot be used a second time. Repeat, going over every inch of the surface until there is not a particle of soap left on it. This avoids the possibility of cheesy spots on the bust. Now rinse very lightly and quickly with water.

The surface of your plaster should now feel quite smooth and slippery. Some casters use a few drops of oil or sterine after soaping, brushing it on *very* lightly.

From this point on there are two ways of proceeding with filling the mold. Each has its merits and disadvantages. If the bust has shoulders, a comparatively small neck and large masses of hair, I strongly recommend this procedure:

Method I—Place the molds side by side on the table. Mix sufficient plaster to line both of them about one inch thick. Mix this carefully and not too thickly and do not stir

too long, for the longer plaster is stirred the more quickly it sets, and the work must be rapid if both molds are to be filled simultaneously. Pour in only a little at first, tipping and joggling the molds and blowing the plaster into every crevice so that no bubbles get caught underneath the surface. Ease the plaster right up to the seam, all around, but keep the seam itself clean and clear.

When both molds are filled with a layer of white plaster from one to two inches in thickness, the bust may need strengthening by putting a metal rod down the center. If possible, use galvanized iron or copper, as ordinary iron has a tendency to rust through the plaster even though it has previously been painted with shellac. Insert this rod with the top end at least 3 inches from the top of the head. Bend it so that it will surely come in the center of the neck, not against a surface. Attach at intervals with plaster-sopped burlap and make the neck almost solid plaster. Now, scratch and roughen the edges of this new plaster, just inside the blue edge of the mold; mix a little fresh and rather thin plaster; pour or paint it rapidly onto this scratched surface thick enough so that it is just a trifle higher than the edge of the mold. Then take up the back half of the mold, turn it over and clap it firmly onto the other half, fitting the keys into their holes as you do so. With your fist, ram the two sections together at the seam, thus glueing them with the fresh plaster which you have just put on. After a few moments, when the plaster is set, tie a rope firmly about the molds or else close up the seam on the outside with strips of burlap dipped in plaster. This will keep the molds from spreading apart as the fresh plaster inside swells.

The other way of filling the mold is the one used for the demonstration in this book. I had deliberately modelled with this method in view. My sitter had no large masses of hair, his neck was strong, I did not include his shoulders, and made the base as simple as possible.

Method II—When the mold is cleaned and soaped and ready for pouring, fit the two sections carefully together and lay strips of plastered burlap along the outside of the seam, completely sealing it. This gives you a hollow shell. Stand this shell upside down with the hole upward on a box or low table, supporting it on three sides so that it will stand without falling yet can be tipped forward and moved about easily. Now mix the plaster for the cast, making it fairly thin and not stirring it too much. With your smaller

bowl dip out a quantity and pour it into the shell, tilting the mold at an angle so that the plaster will run in along the surface of the mold and not splash directly into the center, which would create air bubbles. Now shake the mold a bit and turn it round and round, causing the plaster to adhere completely to the inner surface in a thin film. Pour the residue out into the bowl again and repeat, this time turning and tipping more slowly in order to allow for the slow set of the plaster as you work. If the opening of the neck is large enough (as it was in my bust) a spatula, or your hand, can now be inserted to press the plaster toward the under-cut parts, such as chin and ears. At this stage most of the plaster is inside the head but there should be at least a substantial layer over all the inner surface including neck and base. Do not fill the head up solid, for a hollow cast is really stronger than a solid one and much less heavy. Instead, take strips of burlap and line the neck (the weakest point) with them. This process may completely stop up the neck. Now, more plaster in the base. Make this quite solid, especially if it be small, so that it will be heavier than the head and thus give correct balance to the whole cast. Line the base with burlap but have a care about allowing this to project beyond the lower edge, which, as the plaster begins to set, should be scraped off as even and level as possible.

From this point onward the final steps are alike for the two methods described above. If possible, allow the plaster to set overnight before chipping off the mold. In any case, wait at least an hour, during which time tools can be cleaned and trash cleared away as before.

Then once again spread fresh paper over the floor under and around the stand as well as upon it. Set your mold, right side up, on the stand. With a hammer or mallet and a broad, dull chisel begin to pry up the strips of burlap along the seam and around the irons. Be careful, even at first, not to chip in too deep or to force your chisel at any point. When all burlap and irons are removed, begin at the seam and gradually remove the white outer shell, holding the chisel almost at right angles to the plaster and giving several sharp raps with the mallet. Hold the chisel loosely and be ready always to draw it back the moment it cracks off a bit of plaster. It is probable that, due to your clay slip, this white part will come off first, exposing the thinner blue layer next to the cast. Frequently, however, over some smooth surface, both outer and inner layers of the mold come away together rather abruptly and the chisel must then be ready to spring back

from the mold instead of plunging into the cast itself. Usually the back part comes off in one or two large sections but with the face the procedure must be most delicate, beginning at the top and leaving the mold under the chin and on the base to act as a support until the last (Plate 138a). If the blue adheres in places, do not force it, but pass on to some other section. These flecks of blue are best picked or pried off later with a small plaster tool. Take especial precautions around the ears, using a smaller chisel or screw driver, and never force a piece off. Approach it from a different angle if one seems obdurate. An experienced caster always listens for the faint cracking sound which tells him that a piece is free and no chisel is further needed. But even the most expert caster will sometimes leave a few digs and gouges on his cast, so do not be discouraged if your first cast bears some such scars. A few dabs of fresh plaster promptly applied will fill up little nicks or air holes. Even if a whole ear comes off, it can be replaced in such manner with little difficulty. If any patching has to be done, it is well to do it as soon as the mold has been cleared away and while the cast is still thoroughly moist. For mixing small quantities of plaster, nothing is more satisfactory than one half of a hollow rubber ball. To clean out any plaster which has hardened in this small receptacle, simply turn it inside out and the plaster falls away.

Patching-plaster should be prepared in a special manner. Sift the plaster into the water, but do not stir it. Allow it to stand several minutes until it is "killed." To test this, cut the mixture with a knife. If the plaster closes immediately over the cut it is not yet killed. If the cut remains visible, and the plaster is still soft and pliable, it has reached the "killed" stage and can be used for filling up the nicks and air holes. Have a wet brush ready and wet each spot just before you apply the plaster. Sometimes the brush is also used to smooth the patched spot. If the plaster is not "killed" it will dry out both darker and harder than the rest of the cast.

In patching a dry and dirty cast, prepare it in the following manner: If the cast is not too large, and can be entirely submerged in a bathtub full of water, draw the water and place the cast in it, allowing no portion to project above the water. Let it soak for two hours. When it is taken out, the dirt may easily be brushed off the surface and the whole cast will be sufficiently moist to patch as described.

In a large city where there is much dirt in the air, it is always well to cover a new cast, or a renewed one, with cloth or paper for several days until it is completely dry. Otherwise it will become dirty almost immediately.

METHODS OF FINISHING AND TINTING

Ivory Tinting—Plaster casts look better and stay cleaner if they are given two coats of white shellac, thinned with one half as much alcohol. Using a clean brush, beginning at the top and working down (with not too much liquid on the brush), paint the cast evenly all over. Let first coat dry before applying second. This will give an ivory tone. A little dry color (yellow ochre or sepia) added to shellac gives a darker tone. Beeswax, melted and thinned with turpentine, may be used instead to give a softer bloom.

Bronze Finish—The sculptor Ethel P. Hood, who has had marked success tinting plasters to look like bronze, writes as follows:

"Cover top of stand with oil paper. To a clean white cast apply two coats of shellac. When dry, mix powdered color to general tone desired. (It will dry out somewhat lighter.) Using slightly thinner shellac, paint this on evenly. Two coats may be required. Let dry. Then, using a finer brush and turpentine instead of shellac, add two final coats of color. ('Turps' may take hours, even days, to dry thoroughly.) Then apply fresh floor wax with soft cloth or fingers, being careful not to let lumps of wax settle in crevices. Don't try to cover large areas at one time. Finally, after wax is dry, polish by lightly brushing with a soft lamb's-wool shoe buffer. It takes me about two hours just to wax and polish a head."

Tinting a cast to resemble bronze is a difficult process. No one seems to have discovered an exact formula for it and consequently the result is something of a gamble. Below I give you a formula for making an antique green-bronze patina, but cannot guarantee the results. First, give the cast a good coat of shellac, using a little less alcohol than for an ivory finish. Then mix dark-green dry color with the shellac and apply this as a second coat. When thoroughly dry, paint the whole with a thin mixture of sterine and turpentine. Then with a spatula, mix dry colors on a slab of marble or glass until the quantity is very pale green in color. Now put some of this into a twist of rather loose-meshed cloth and *pounce* or shake this upon the waxed cast, being careful not to touch the surface with the cloth. This will form a thick coating of light green upon the cast. If you find some spots still remain bare of this color, apply a bit more sterine to them and again dust with the powder. Continue powdering until the bust will hold no more. After waiting, perhaps an hour, for this wax to set, proceed with a dry, clean brush to remove such powder as comes away

readily. Much will adhere to the wax and that will give the ultimate color of the cast. If in places too much seems to come off and you are sure that there is sufficient grease underneath, another application of the pounce bag to the doubtful spots will give the desired result; or the color can be rubbed into the spots with the finger. Needless to say, the resultant surface is not uniformly colored but for that very reason it will more closely resemble bronze than would a coat of paint. If the cast now looks too green, add a few dashes of complementary color, such as red, violet or black. If possible, while tinting the plaster, have near by a piece of real bronze patined as you like it, and make your color resemble it. When the greased and powdered cast is thoroughly dry, polish it with a rag or a brush to bring out the high lights. If desired, a bit of bronzing liquid may be used on projecting bits to appear like metal shining through the patina. My own experience is, however, that bronze paints rarely look like bronze when applied. A bit of powdered graphite, rubbed on with the finger gives a burnish which, to me, is more effective.

Another way of obtaining a metallic patine is to use a coat of real silver or aluminum leaf. This can be bought at most good paint stores in little booklets. Leaf silver comes in sheets a few inches square. To make this adhere a "size" must be used.

The entire process is as follows: Paint the cast with a good coat of shellac. If the cast is old and very dry, give it two coats. In about an hour it will be ready for the size. Gold sizing, or size, can be found in any paint store. Use this direct from the can, painting on quite freely and making sure that every hollow is lined—ears, nostrils and the under chin. This size must dry for at least three-quarters of an hour before it is the proper tacky consistency to hold the silver leaf. Then with a dry, soft brush pick up a sheet of the silver. It is difficult to handle, as it is so light that a mere breath will blow it away and it tears almost at a touch of the brush. Lay this on the cast, dabbing it firmly to the sticky size with the brush. If cracks appear, cover them at once with smaller bits of silver leaf. Let the edges overlap. This is better than finding unsilvered spots later on. Some scraps of the silver will peel off and blow away, but this small waste cannot be avoided. The main thing is to press the silver with brush and a soft wad of cotton or cheesecloth into every slightest depression and bit of modelling, making a thin film of silver over the work. When this is done the cast will look too shiny and will need toning down. Oil color and turpentine are good for this. Use a dark brown made of black, burnt umber, dark blue, a dash of green or of red mixed thin enough to wash over the surface as you brush it on, but not too thin to be effective. Before doing this the silver must again

be completely shellacked and allowed to dry thoroughly. Then mix enough color to cover the entire cast, otherwise a second mixing may vary in color and result in a mottled appearance. Now with brush in one hand and soft cotton or cloth in the other —ready to remove color quickly if it is too dark or settles too much in the hollows— paint rapidly over the silver. The turpentine in the paint will cause it to flow easily and also keep the color from drying before you have wiped it off with the cloth. This wiping will leave the high spots almost pure silver, or bronze, while the darker tones remain in the hollows. The results obtained run anywhere from slightly tarnished silver, through oxidized silver to almost black. Do not let anyone persuade you that silver or bronze powder is as effective as the leaf. It is not and always presents a cheap result. Never begin to treat a cast in this manner unless you have plenty of time, for it often takes an entire day to get the result desired, and when once begun your work must not be interrupted except while the shellac or size is drying.

Stone Finish—To make a plaster cast look like stone I have found the following method satisfactory. First shellac, then paint the cast with ordinary light gray house paint. When it is dry, mix various light dry colors—white, yellow, pink, pale blue, etc. —in some stale beer. Put the mixture into a sprayer such as gardeners use for applying insecticide (if the cast is a large one) and, standing several feet away, spray the cast with it. It will fall in tiny drops upon the surface, giving it a granular appearance, and breaking up the solid gray color underneath. For a small cast, such as a head, a fixative blower and plenty of lung power will give a similar effect.

Sandpaper Finish—Of recent years, apparently owing to the great skill acquired by those of our sculptors who have developed this technique in Rome, sculptors have tended to work more and more over the surfaces of their plaster casts until the results are so finished and so like marble that the dead white plaster cast has become in their hands a very exquisite thing. Many sculptors, indeed, have so perfected this plaster craftsmanship that they spend quite as much time upon it as upon the clay modelling. Often the decorative hair or drapery on their figures is not modelled at all, but is carved directly in the plaster, either in the mold or upon the finished cast. No half measures will suffice for this treatment. If you are determined to give the head a perfect surface, every inch of it must be gone over. Beginning with a fine rasp, scrape the entire surface, being careful not to obliterate your forms in so doing, but rather to accentuate them by eliminating all the tiny accidental flaws and fingermarks which modelling

inevitably entails. Once the rasp has done its work (and the cast must be bone-dry if rasp and sandpaper are used) increasingly fine sandpaper or emery cloth must be employed until a surface as smooth as an eggshell is obtained. Plates 32 and 92 offer fine examples of this treatment as executed by some of our most distinguished sculptors. Undoubtedly, classic figures, or those purely decorative or symbolic, are the best subjects for this treatment. It would be sadly inappropriate to use it on a portrait statue of a Rough Rider.

GLUE MOLDS AND PIECE MOLDS

The inquiring student often asks: "How do you make several casts of the same piece of sculpture, if the mold is always destroyed in casting?"

The limitations of this book prevent any thorough description of the processes of glue (or gelatin) molding, and of piece molding. These are, moreover, matters which are best left in the hands of an expert caster. But a brief résumé will at least give the student some idea of what is done.

Practically all modelled work must first be cast by the waste-mold process described in this chapter. That is, the caster must have a first plaster cast from which to work. If several copies are needed, he usually makes a glue mold as follows:

First he shellacs the plaster cast; then, rolling out large slabs of clay about an inch thick, he covers the entire cast with this blanket of clay. Over this, he makes a thick shell of plaster, leaving a seam, so that the shell can be removed in two halves. The shells are then taken off, the clay blanket removed, the plaster cast greased and the shells replaced over the cast, leaving an empty space where the clay was. Meantime, a large pot of evil-smelling glue or gelatin has been boiling to the required consistency. The caster cuts a hole in the top of the shell, inserts a funnel, and pours the glue inside, making a glue mold over the cast. When this has cooled and stiffened, it remains fairly pliable and rubbery. Removing the shells, the caster carefully cuts the rubberlike mold in one or two sections and removes it from the plaster cast, laying the sections in their places in the outer shells. By filling this glue mold with plaster he makes another cast and, when it has hardened, the various sections of glue mold can be pulled away from the plaster without catching in the undercuts. Thus a number of casts may be made from one glue mold, although eventually the glue will warp and blur somewhat, and if used too often, will not produce a clear and perfect cast.

Piece molding must also be made from a first cast, but is done differently. The

caster makes his plaster mold in a great number of sections, calculating with the greatest nicety so that each small piece will lift off without catching in undercuts. Over this "jigsaw puzzle" of a mold, an outer shell is built, in which, when removed from the cast, the pieces will nest perfectly.

Not all casters are skillful at this type of casting and most of them prefer the glue method. In Chapter XV, Mr. Basky describes a similar piece molding in fine sand, which is one of the processes of bronze casting.

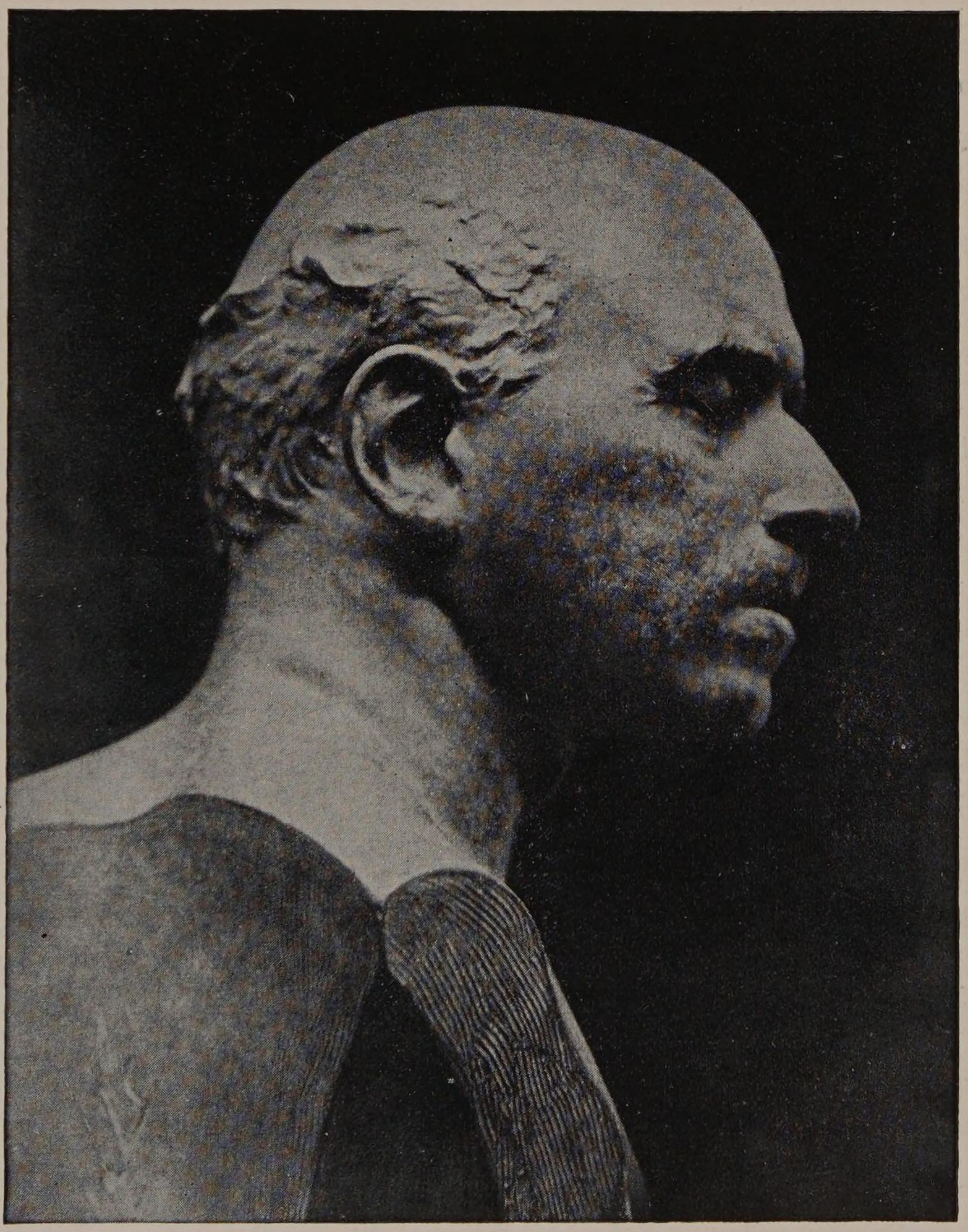


PLATE 139. Pablo Casals, *Bronze*, by Brenda Putnam

CHAPTER X

DRAPERY

THERE is as much logic and "anatomy" in inanimate drapery as there is in the living body. Woven materials obey physical and mechanical laws which are not to be broken. Particularly is this true of the law of gravitation.

Diagram 81 shows how folds fall when suspended from a single point. Diagram 82 shows how the "eyes" appear when the cloth is suspended from two points. Diagram 83 shows how the folds collapse, break and spread out when they encounter a level surface. Try pinning up a cloth in various ways, and sketching the various folds, accentuating the "eyes" as most of the old masters did in their studies of drapery.

The understanding of the construction of a single "eye" is the basis of an understanding of all drapery. For practice, in applying this to sculpture, roll out a long "bat" of soft clay (not plasteline), then bend it sharply in the middle. Try this, and notice how vigorously the clay around the "eye" thrusts up, making a peak that is higher than the rest. This is what happens, to a greater or lesser degree, in every fold of cloth, whether it be big and bold, as in stiff, heavy material, or barely discernible, as in fine muslin or cheesecloth. Every change in the pull, or direction, of folds automatically produces these eyes. Even if you are using a very "stylized" treatment in which the drapery of the figure is reduced to mere surface ornamentation, though you flatten these eyes as much as you please, you must still recognize them, or your drapery will be completely unconvincing.

I advise every student to do some "drapery exercises" such as are shown in Plates 140, 141, and 142. No. 140 shows a piece of silk arranged on a board ready for copying. No. 141 shows a plasteline copy of the same subject. This is a fairly literal interpreta-

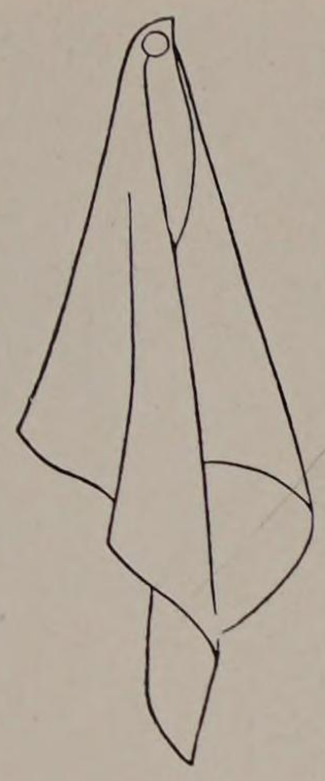


DIAGRAM 81

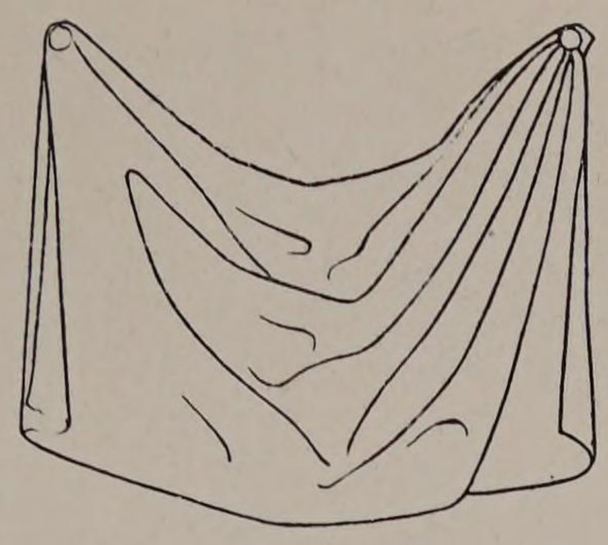


DIAGRAM 82

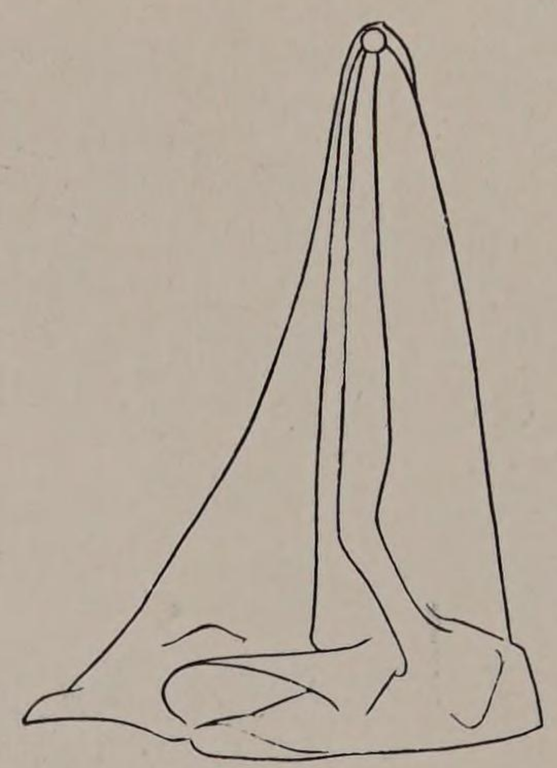
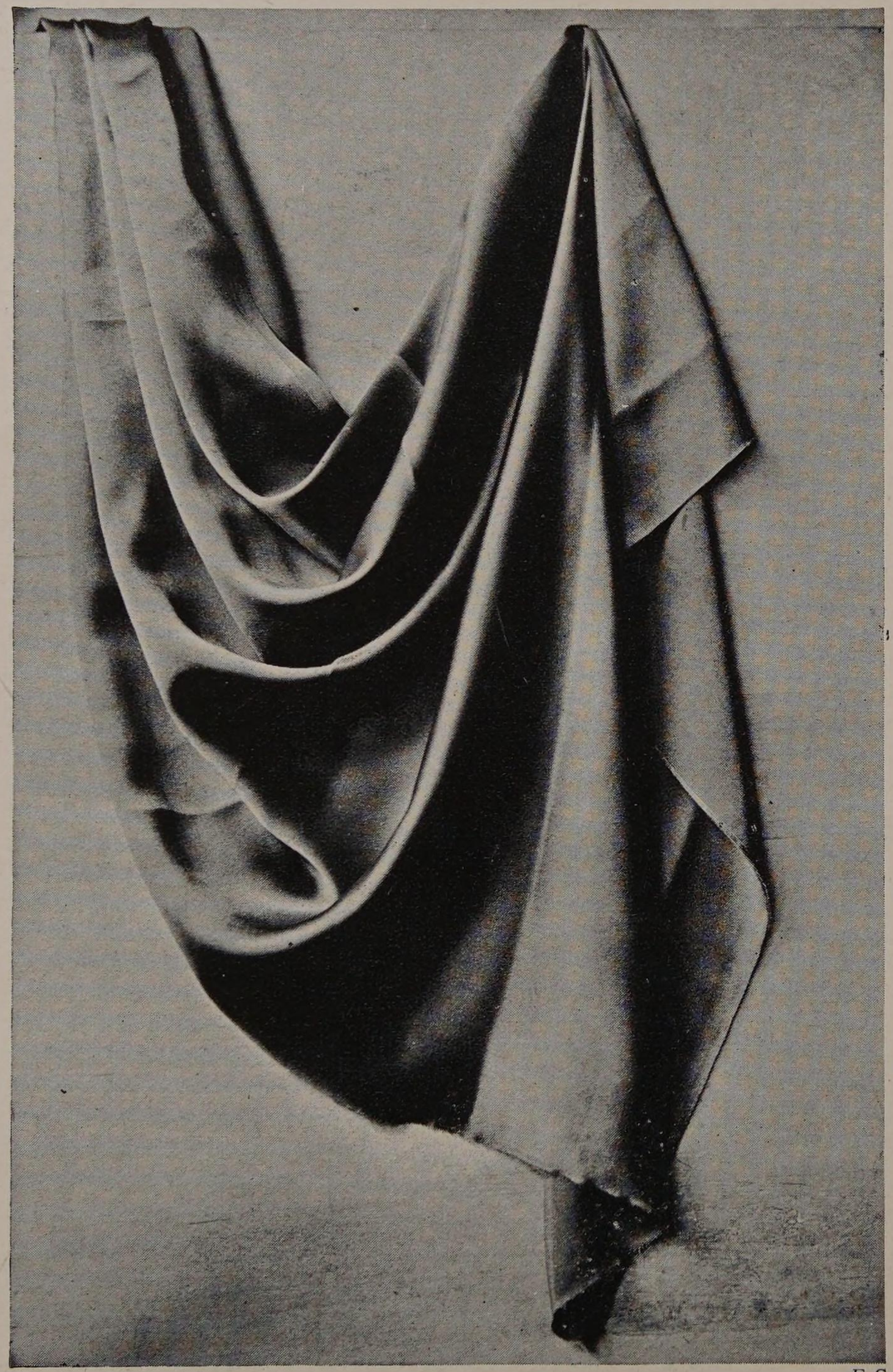


DIAGRAM 83

tion, done more for practice than for artistic purposes. The slight creases in the actual silk, being entirely accidental and not a part of its construction, have been omitted. Having made a number of faithful studies such as these, one may then interpret the same subject by adapting it, as it were, for a more architectural treatment to be carried out in stone (Plate 142). All the deep undercuts of the material must be eliminated, and the folds simplified and strengthened—with flat planes rather than curves for the tops of the folds and sharper angles where the folds break.

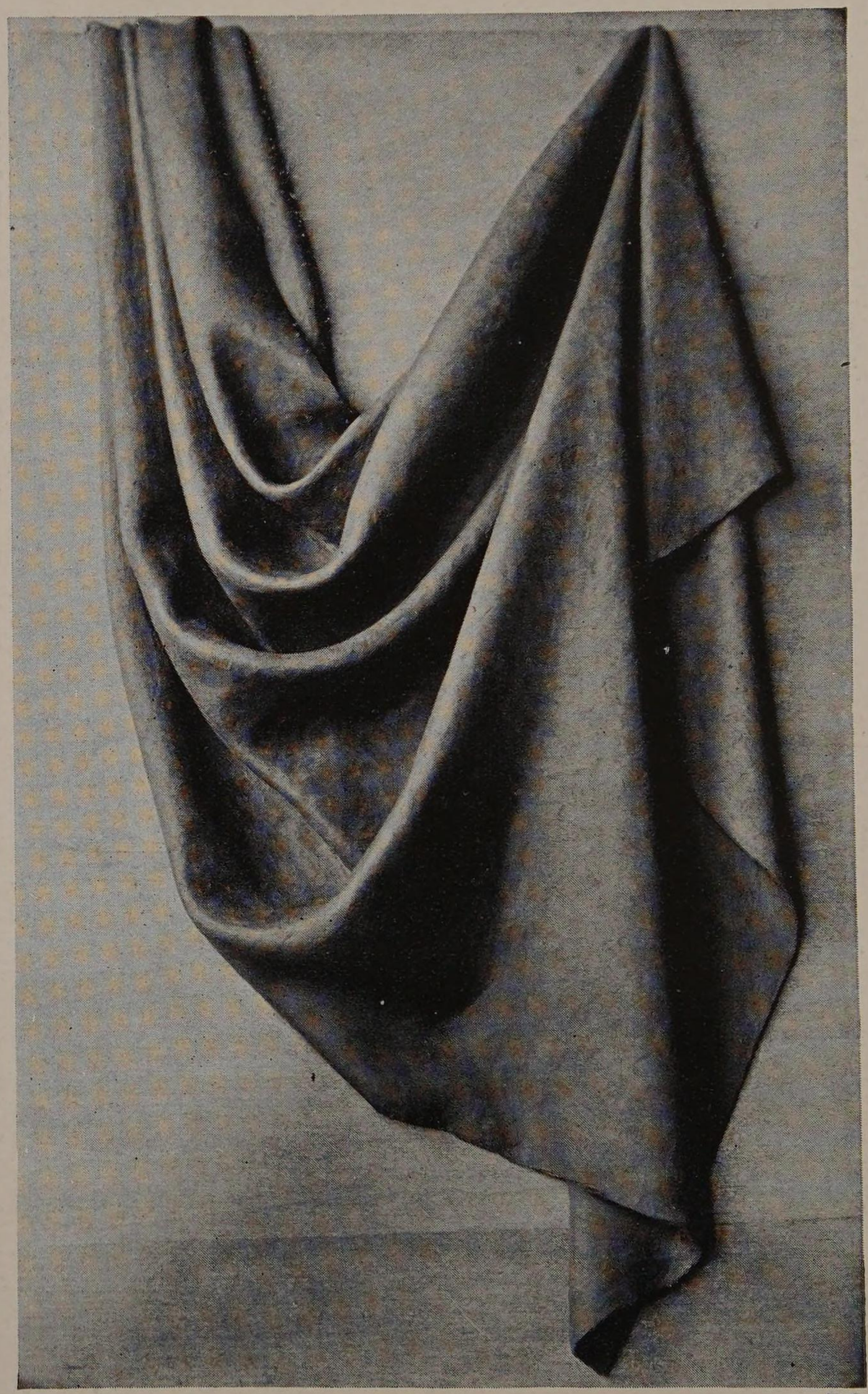
Curiously enough it is easier (once one has mastered the fundamentals of human construction) to model a figure without a living model, than it is to clothe that figure without referring to actual drapery. The shape and direction of the main folds are determined entirely by the contours of the figure beneath. Your drapery will "make sense" only if you study the real thing.

The difficulty with living draped figures is that every time these models rest and change their positions, the drapery changes, too, and can almost never be readjusted to the original folds. For this reason many artists use a lay figure for drapery. Some of these are life-size creatures, costing far too much for the average student. But small, jointed 15-inch mannikins may be procured at any art store at small cost. In designing the drapery for my figure of "Puck" (Plate 143) I used one of these. When the dummy had been properly posed, I took some quite thin material and dipped it in water in



E.S.

PLATE 140. Drapery Arranged on Board



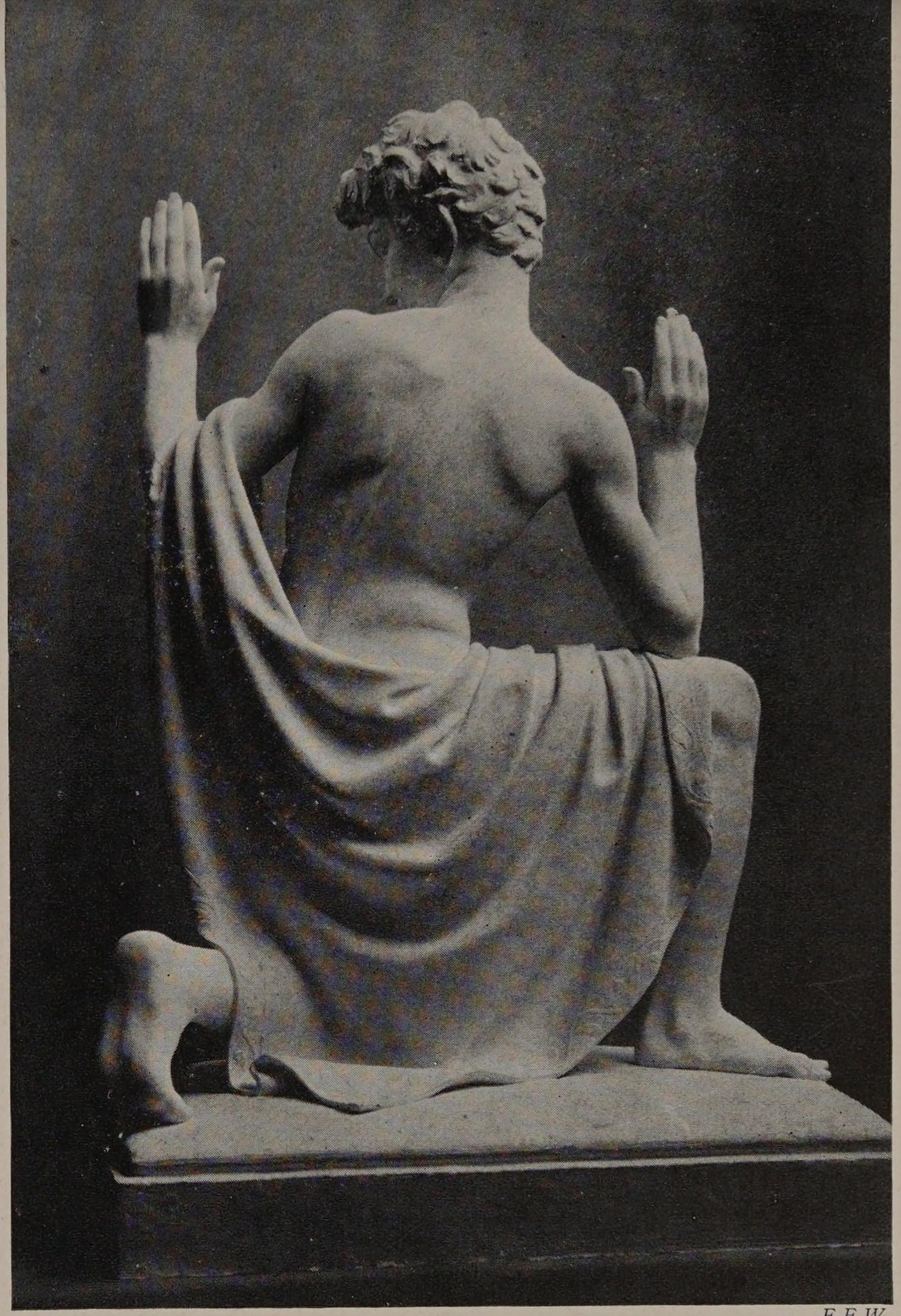
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PLATE 141. Plasteline Study of Drapery



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PLATE 142. The Same, Modelled for Stone



F.E.W.

PLATE 143. "Puck," *Marble*. Brenda Putnam



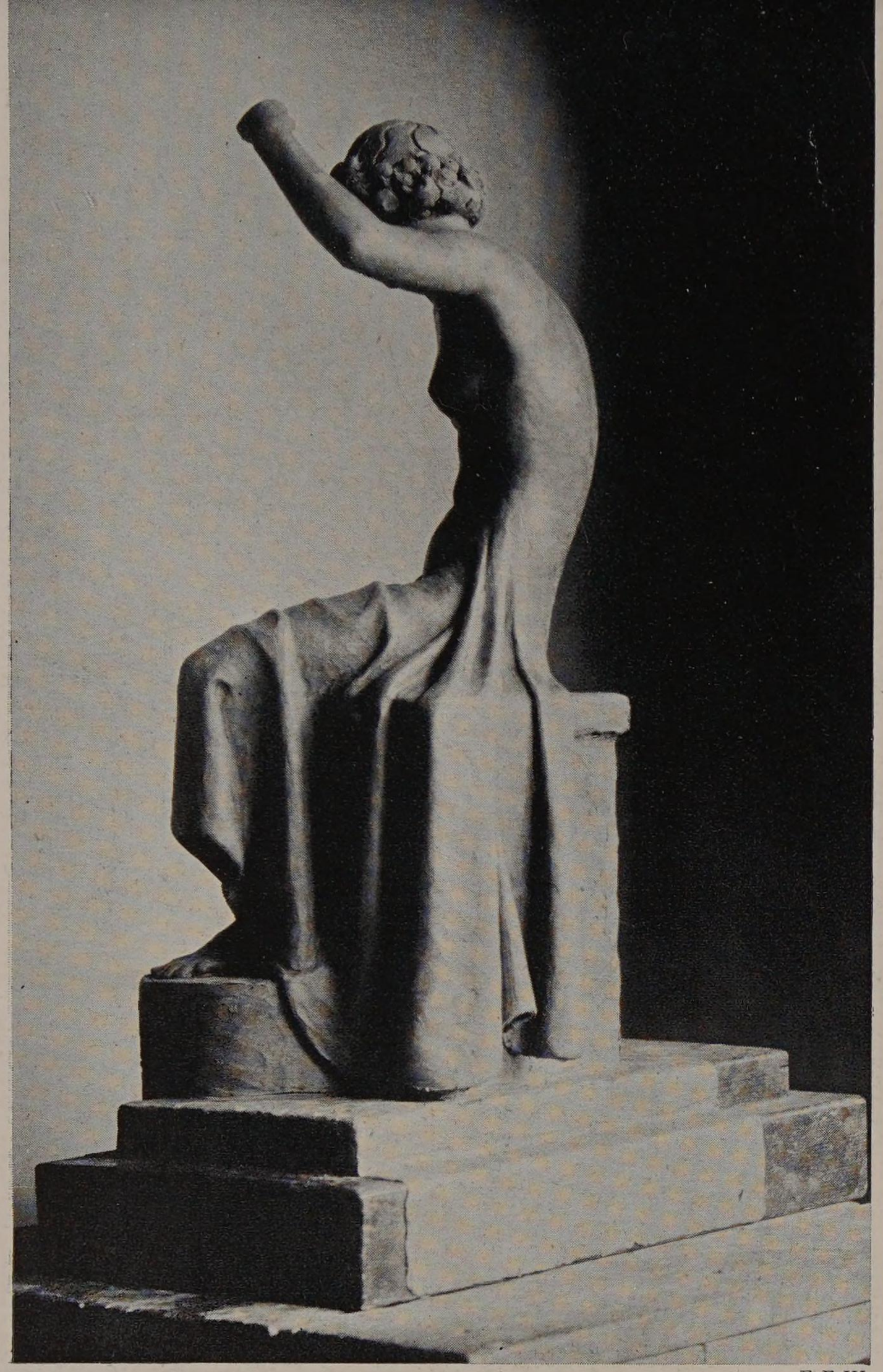
F.E.W.

PLATE 144. Study, *Nude*



F.E.W.

PLATE 145. The Folds of the Skirt Laid On



F.E.W.

PLATE 146. The Folds of the Skirt Laid On



F.E.W.

PLATE 147. The Finished Figure

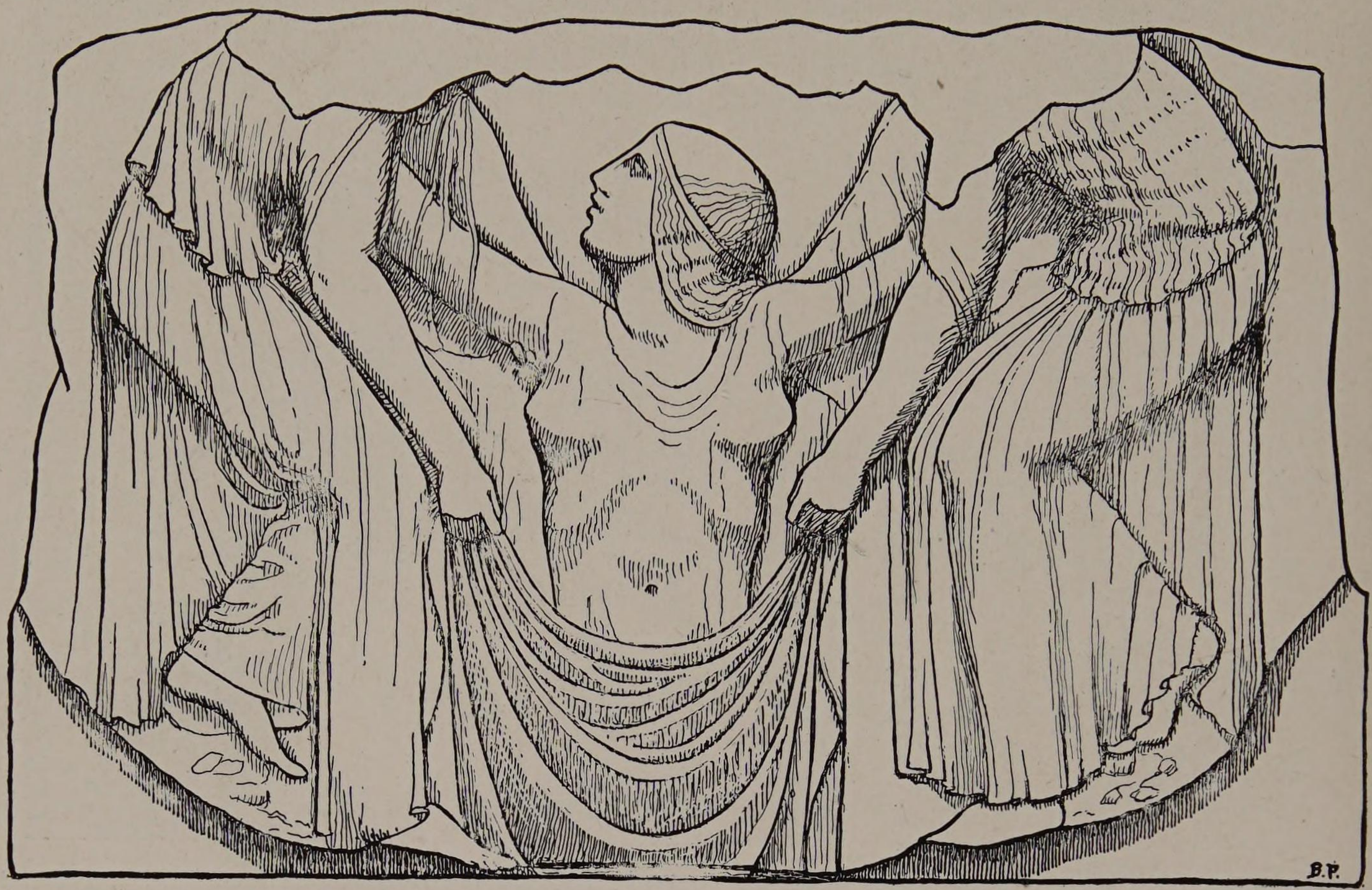


DIAGRAM 84. Birth of Venus, Early Greek

which a few drops of glue had been dissolved. While the cloth was still wet I hung it in approximately the desired position, allowing it to fall naturally. Then, without changing the main directions, I arranged the folds as "sculpturally" as possible; then trimmed off loose ends with scissors. When the cloth had dried, the glue set and held the folds as I had arranged them. In interpreting them, I naturally eliminated a number of small, accidental creases. Notice the several strong "eyes" made by the folds as they converge to fall over the thigh.

Most figures are first modelled in the nude and then draped. In Sargeant Jagger's book, *Modelling and Sculpture in the Making,* which I hope you will read, there is a practical suggestion to eliminate the possibility of cutting into the figure while modelling the heavy folds of drapery superimposed on it. Mr. Jagger wraps his nude clay figure in a sheath of muslin or cheesecloth, so that when later he digs too deep into the folds of the drapery, the muslin warns him that he must not cut so deep. Another



Courtesy Metropolitan Museum of Art

PLATE 148. "Charioteer of Delphi," *Bronze*

solution might be to make the figure in one shade of plasteline and use a different shade for the drapery.

Even in the exquisite "Birth of Venus" (Diagram 84), though it dates from the middle of the fifth century, B. C., the draperies seem hardly more than drawn on the surface so that one may appreciate to the full the beauty of the figures underneath. Venus herself, indeed, looks dripping wet as she emerges from the sea; her drapery is all but invisible, yet even its folds obey those primary laws referred to at the outset of this chapter. Study the way in which the crepe-like material checks against the bent legs of the handmaidens, and then compare with Michelangelo's angel, robed in a heavy woolen garment (Diagram 86). Most people are familiar with Michelangelo's nude figures, such as the "David" and the "Slaves," but they are inclined to forget that he was also a supreme mastery of drapery.

Drapery in primitive sculpture clings closely to the figure and the folds are hardly more than drawn upon the surface. Yet what beautiful drawing it is!

One of the earliest and finest examples in which drapery is treated both realistically and decoratively, yet with an exquisite sense of design, is the "Bronze Charioteer of Delphi" (Plate 148) of the early 5th century. The skirt of this tall, grave figure falls in unbroken folds from the high waist to the hem—folds varied just enough to suggest life and movement, yet similar enough to enhance the perpendicular and to give the whole figure the charm and dignity of a fluted column. Visitors to the Louvre in Paris have no difficulty in finding the famous "Winged Victory," commandingly situated halfway up the great staircase. She always has her throngs of admirers. But in a small gallery beyond her stands this lonely, motionless "Bronze Charioteer." What a contrast to the restless sweep of the windblown "Victory," with her fluttering and complicated drapery!

In her triumph she is glorious, and the very sight of her uplifts the heart. Yet even she might cause weariness if we looked too long at her. With the Charioteer we relax; this is something we could live with, day in and day out, never tiring of its serene nobility.

Romanesque and Byzantine art, one must remember, knew nothing of the achievements of the Greeks. The treatment of drapery, from the 9th to 11th centuries, was derived mostly from Persian illuminations and other Eastern art, which came from Constantinople and from across the Mediterranean. They practically began all over again, in their crude attempts to carve the human figure, which, during the first ten

centuries, was used solely as a decorative accessory to architecture.

Even as late as the 11th and 12th centuries, we find at Vézelay, Moissac, and other very ancient abbeys, a marked Persian influence in the delicately swirling draperies of the attenuated figures. Plate 149 shows the central figure of the great tympanum at Vézelay. Diagram 86 shows the distinctive drapery on the figure of one of the evangels.



Courtesy Metropolitan Museum of Art

PLATE 149. Tympanum, *Detail,* at Vézelay

From such beginnings evolved Gothic sculpture, with its characteristic tall, grave figures. The limits of this book make it impossible to include pictures of them, but the student will find absorbing material for study in such books as Emil Mâle's *La Sculpture et L'Iconographie du XIIIième Siècle;* Arthur Gardner's *Medieval Sculpture in France,* and others. And most of our museums boast a number of fine examples of the wood and stone carvings of this period, while in the Trocadero in Paris there is a veritable sculptor's paradise consisting of plaster casts of masterpieces from all the great cathedrals of France.

In Burgundy, during the 15th century, some remarkably fine draped figures were *pleurants,* or "weepers," who attended the funerals of great folk in those days. One such figure is reproduced in Plate 152. It is interesting to compare this figure with that made by our own Saint-Gaudens some four centuries later (Plate 153).

During the latter part of the Italian Renaissance and continuing almost to our own day, sculptors, unfortunately, became more and more absorbed with the skillful and literal rendition of various textiles, and lost entirely the sense of a decorative unity between figure and clothing which was so vital a part of earlier sculpture. To figures

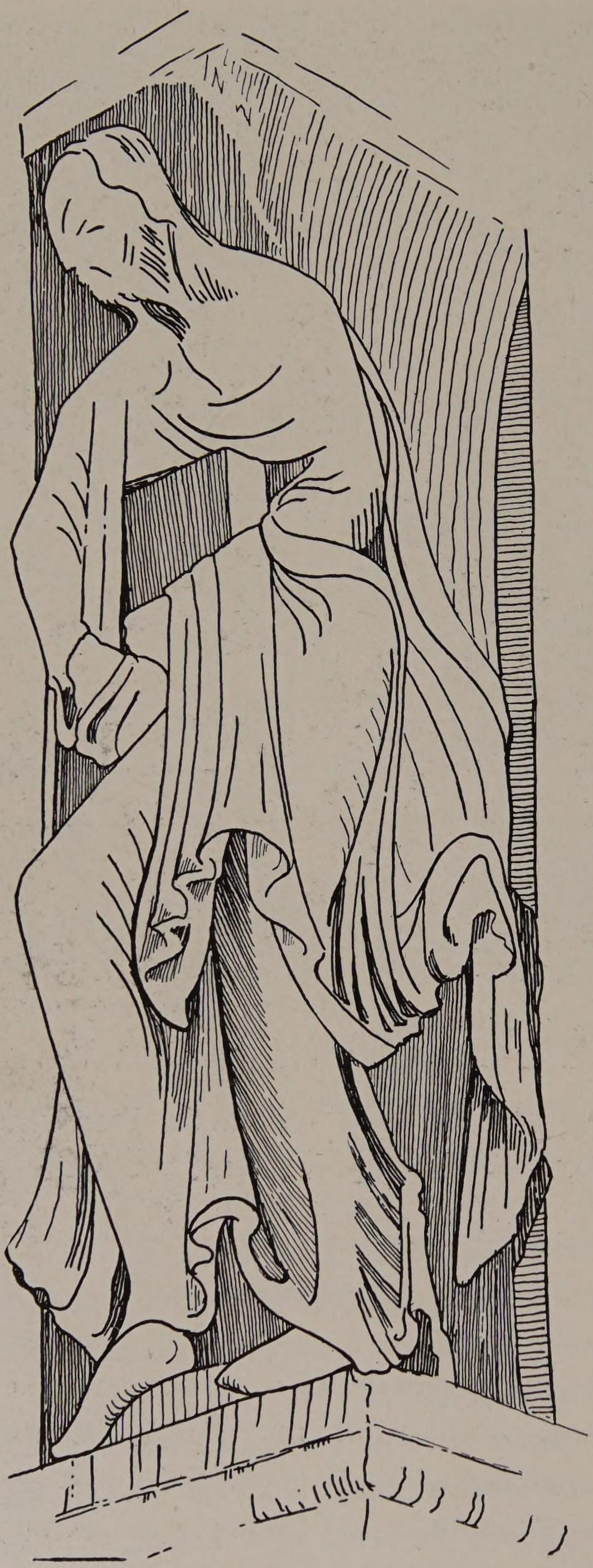


DIAGRAM 86

standing in artificial and theatrical postures they added flamboyant draperies, vying with one another to see who among them could make the cleverest counterfeits of laces, ribbons and voluminous silks and satins. Skill replaced art and the essential static quality of sculpture was completely forgotten (Plate 154).

With Thorwaldsen, Flaxman and Blake, in the last century, there was a half-hearted return to simple, classical drapery, but the public in general had learned to expect a very literal representation of garments on the portrait statues of their great men and the great majority of sculptors, even in our own time, are obliged to cater to public taste in this respect.

One of the triumphs of a man like Saint-Gaudens is that he was somehow able to combine a certain literalness with an exquisite taste and nobility of vision which sublimated even the ugly masculine clothing of his day. Trousers—shapeless cylinders as they are—under his magic hands became almost beautiful. Witness his "Lincoln" in Chicago, and the "Farragut" in New York. It would indeed be interesting to see how he would treat drapery today, with all the new-found "freedom of expression" now being encouraged.

The general trend at present, in healthy revulsion against both the extravagances and the literalnesses of the past, is toward simple or archaically stylized drapery. But



PLATE 150. Joseph and Mary, *Wood*, by Brenda Putnam



PLATE 151. 16th Century Figure, *Wood*

a certain danger lies in reducing drapery to such a minimum that we fail to make use of its possibilities for enhancing the decorative quality of our work. If we simplify and eliminate *too* much, we end by having nothing at all! (Plate 155.) This is just one of a number of amorphous creations which I have seen in my visits to classes and studios where young aspirants were learning "to express themselves."



PLATE 152. "Pleurant." Claus Sluter or Jan de Werve

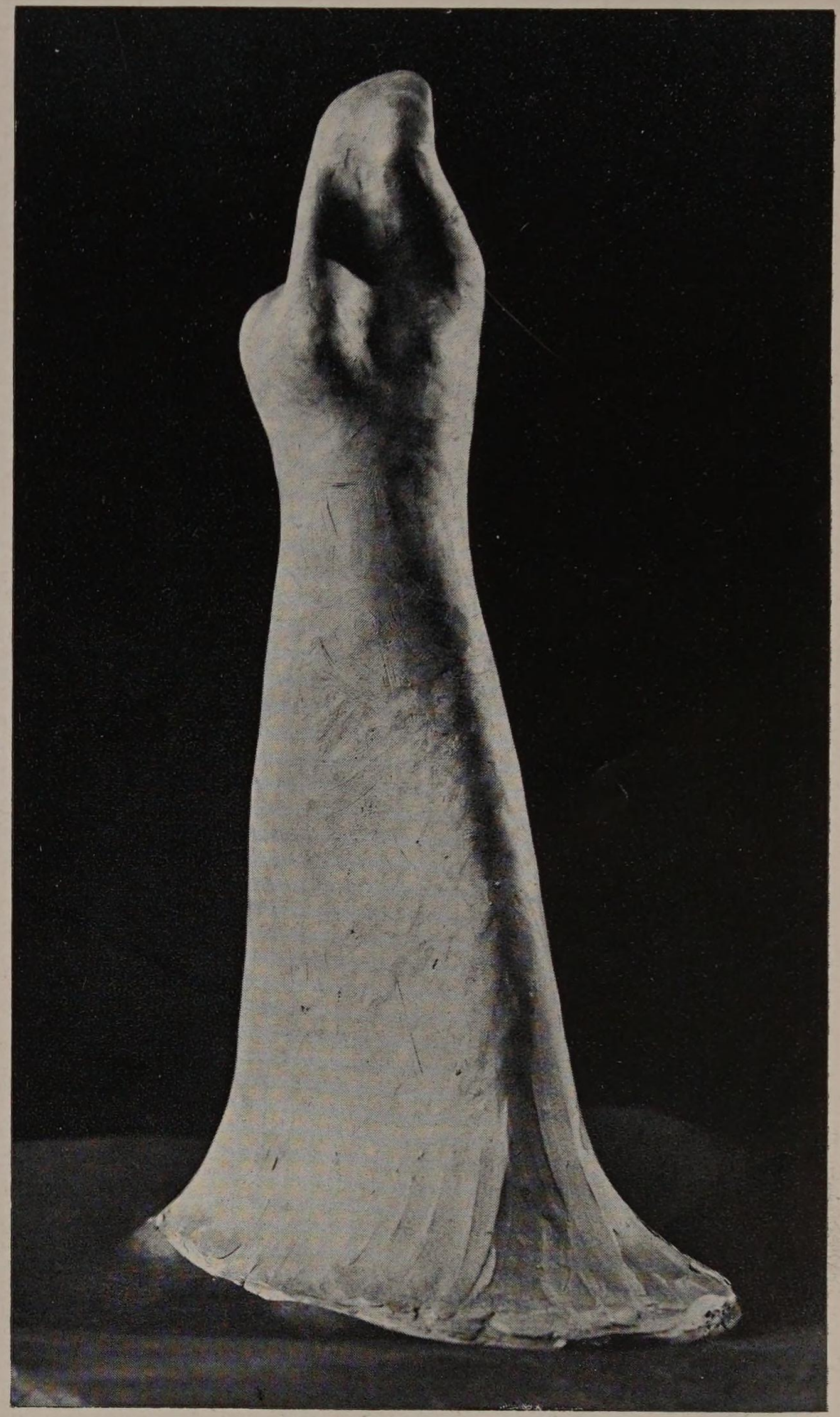


PLATE 153. "Adams Memorial." Augustus Saint-Gaudens



Courtesy The Frick Art Reference Library

PLATE 154. Angel. Bernini



E.S.

PLATE 155. A "Nothing"



PLATE 156. War Memorial, *Rear View, Bronze.* Libero Andreotti

I strongly suspect that much of the attraction which such diluted figures hold for the would-be artist, lies in the vaguely sensuous pleasure experienced in "smoothing things down." This is instinctive with all of us, I suppose, but rather disastrous to the student who lets the habit get a hold on him before he has really learned to express forms with boldness and conviction. Like some anemic violinists who can play nothing but minor tunes (pianissimo with the mute on) they would be aghast and helpless were they suddenly commanded to plunge, fortissimo, into the brave opening chords of a Bach chaconne!

In contrast to the decidedly negative creation shown in Plate 155, I give you the rear view of one of Libero Andreotti's dynamic war memorials (Plate 156). Here is masterly handling of drapery. Vigorous and alive, it is yet wholly sculptural and massive in treatment, contributing immeasurably to the force of the group.

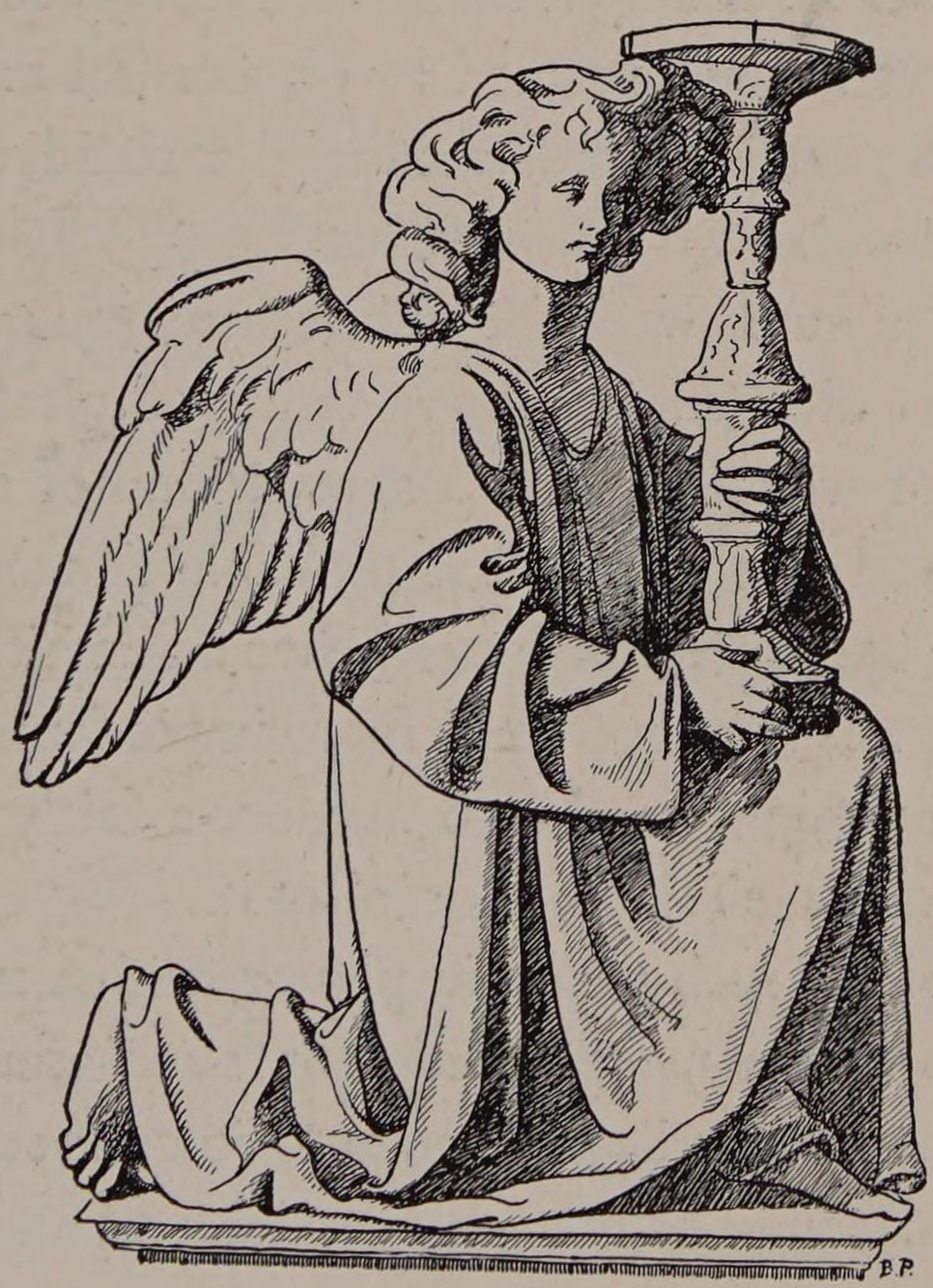


DIAGRAM 86A

CHAPTER XI

RUNNING TEMPLATES AND ENLARGING BY HAND

THE dictionary defines a template, or templet, as "a gauge, pattern, or mold, commonly a thin plate or board, or a light frame used as a guide to the form of the work to be executed." Templates are widely used by ornamental modellers and plasterers, who must make long strips of architectural molding that could not possibly be modelled accurately and quickly by hand.

If you expect to design much work for architecture, you must familiarize yourself with the various methods of "running" long strips of plaster moldings, pilasters, cornices and balls, each of which requires a special kind of template. Such jobs are mostly done by professional casters, but it is probable that occasionally you may be called upon to do a large bas-relief which must have an architecturally true and exact border. Or again, you may need a round basin for a simple fountain design or birdbath. With a potter's wheel, you might be able to turn out a fairly symmetrical shape, but otherwise fingers and clay will make but a poor job of it.

It is much better to shape such things in plaster, with a template, and know that they are true. Suppose you wish to make a border, or frame, around a bas-relief and that the molding you have chosen looks like Diagram 87 in cross section. The first thing to do is to make a full-size drawing of this cross section on paper and cut off along the lower edge. Now take a sheet of tin several inches larger than the drawing. Lay the drawing on the tin with bottom edge of paper against bottom edge of tin. Stick the paper on with glue and, with a shoemaker's awl, prick through the outline onto the tin, just strongly enough so that the shape is lightly dotted on the metal. With a pair of metal shears, cut the tin around the pricked outline. The section that is the same shape

as the molding is discarded; what you are to use is the remainder. This will be your template, or "mold."

Now take a straight board considerably longer and somewhat wider than the tin, lay this upon it near the left-hand end, and draw the outline of the tin on the board. With a ripsaw, cut away the board as you did the tin, but cut about one-eighth of an

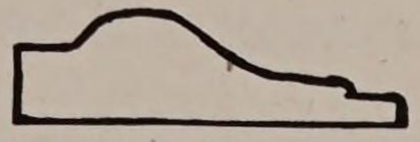


DIAGRAM 87

inch deeper than the pencil line. In Diagram 88, dotted lines indicate outline of board. Now lay the tin back on the board. Tin and board should be flush at the bottom, but around the design the tin will project one-eighth of an inch lower, to make a cutting edge. With the awl, punch a few holes in the tin and nail firmly to the board with small brads.

Now a second board, exactly the same height, must be nailed at right angles to the right-hand end of the first one, which we will call Board A. Board B should be firmly

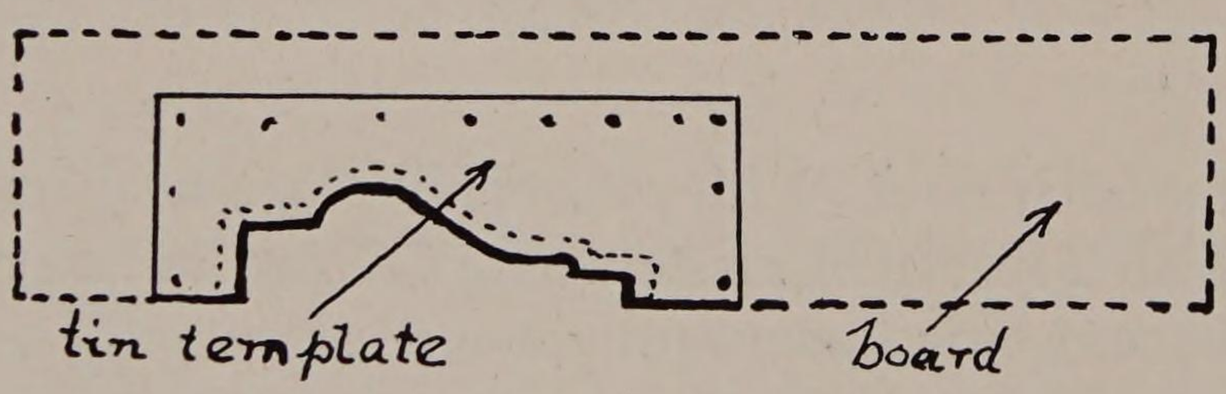


DIAGRAM 88

secured by toeing the nails, so that it is immovable. Make sure the two boards are flush with each other and at exact right angles. Lastly, two thin cleats, C and D, will be needed. Nail C across the top of the boards, from the outer corner of A to the right-hand corner of B. This will act both as a brace and as a handle (Diagram 89).

You are to run your template along the near edge of a rectangular slab of marble with a true straightedge. Such slabs (old bureau and washstand tops) can usually be picked up at second-hand furniture dealers'. Set the template with board B lying exactly along the edge (Diagram 89 shows template in position) and fasten cleat D along the outer and lower edge of B. This cleat, called a sled, should project about an inch lower than B and slide along the outer edge of the slab, preventing the template from

slipping in from the edge as you push it. Now smear a little grease on both the marble and the sled. This grease, which should always be a part of one's studio equipment, is made by melting down a lump of sterine or parafine in an equal amount of kerosene. It is safest to heat this over a low flame in a double boiler, or it may catch fire. Allow to cool somewhat, then pour into a wide-mouthed Mason jar, and keep handy in the studio, setting aside with it a soft, round brush for applying the grease. If mixture jells, place near stove or radiator until it becomes liquid.

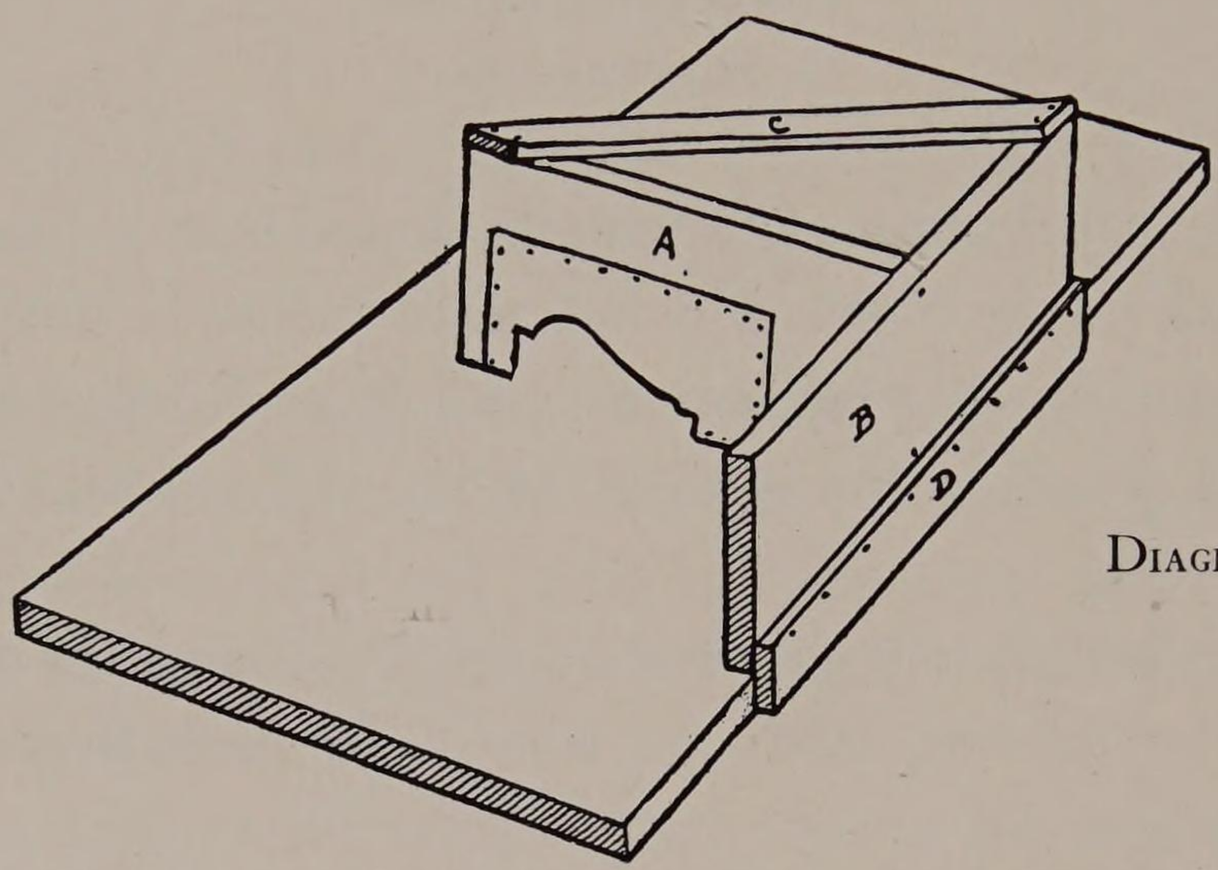


Diagram 89

Mix some plaster fairly thick. With your template set away over at the right-hand end of the marble, pour a stream of plaster along the slab where you calculate that the tin will scrape. Now, with firm downward pressure, shoving the sled close against the edge of the slab, sweep the template over from right to left. It will pick up some plaster as it goes. Pour on more plaster, *lift* the template back to the right and sweep again, repeating this process and adding fresh plaster where needed, until your molding begins to take shape. By this time, any plaster you have left is beginning to set. Throw it away and use fresh, rather thin, plaster for the final layers. Repeat the sweeping and lifting process until you have a long strip of perfectly uniform molding.

It should take less than a day to do all this, whereas if you had attempted to model the molding by hand and were conscientious about getting it even, you would work for a week on it, with very poor results.

When you have made enough strips to go all around your relief, cut the ends off clean, mitering them for the four corners. You can shellac these moldings when dry and lay them around the edge of your relief, casting them when you cast the whole thing,

or else simply set them aside until the relief is cast in plaster and fasten them to the cast with glue, burnt shellac, or a "slip" of wet plaster.

The template described above will do only for straight moldings. For circular forms, a different kind must be made, one which will revolve around a central axis, or

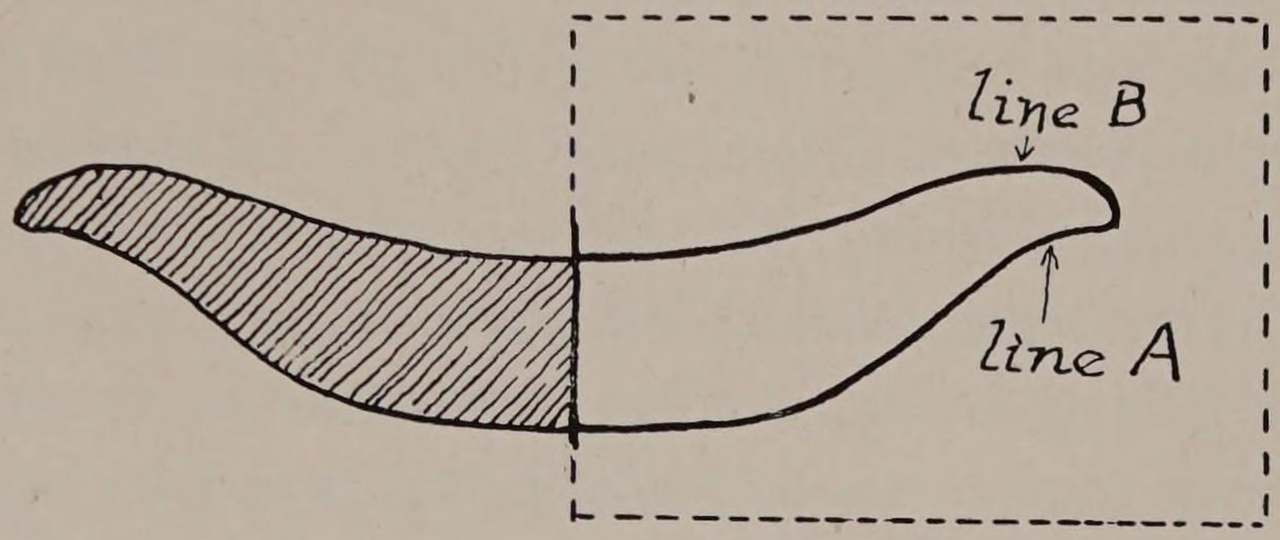


DIAGRAM 90

pivot. For a slightly concave disc, such as one might use as the basis of a coin, the process is fairly simple. The template is cut in tin and nailed to a board in the same manner. But this time the left-hand edge of the board is fastened to a pin sticking upright in a small hole drilled in the marble slab, and the board is swung around and around on this pin, or pivot.

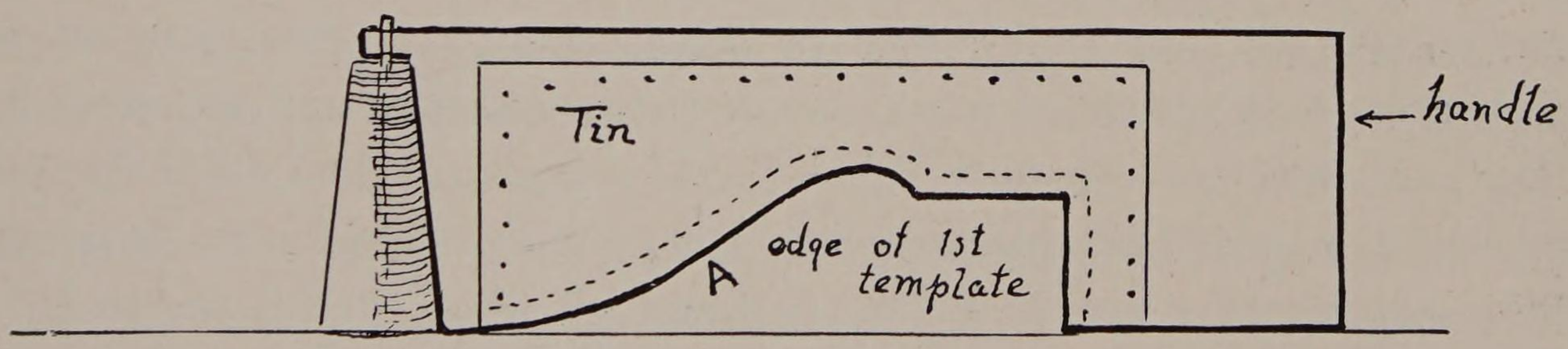


DIAGRAM 91

A birdbath, or any other basin, is more complicated because both upper and lower surfaces must be shaped. This is done by making two templates, or rather by readjusting the one, after it has made a mold for the bottom of the basin.

Suppose that you wish to make a basin of which the cross section resembles that in Diagram 90. Naturally your template need be only of the right-hand half of the basin, from center to lip. Make a full-size drawing of this, then cut a tin template of the lower outline, line A. The left-hand, or inner edge of the template board must be shaped to

fit around a central cone, made of wood, into which a nail, or pivot is driven. This cone is used, because any pin as long as the entire depth of your basin, would wabble or bend as pressure was applied. Cut the board so that there is, at the top, a projecting "tongue," through which the pivot may be nailed into the cone. Note that line A of the template itself, in Diagram 91, does not stop at the lip of the basin, but is extended several inches toward the right-hand end of the board. This will allow for more plaster to give added strength to the *mold* for the base, which you are now about to make. Grease the marble slab and pour plaster in a ring just in front of the template. Swing this completely around and around, adding more plaster, until this bottom mold is complete.

Now detach the template board, lay it flat, and trace and prick on the tin the *upper* outline of the basin (Diagram 90, Line B). Remove the tin, cut away both it and the board on this new line; replace on the pivot. By this time, the plaster mold should be dry. Soap it as you would any other mold, so that fresh plaster will not adhere. Grease cone and slab once more. Mix plaster, pour onto the plaster mold and swing the template around until the basin is complete. Remove the template and cone, fill up the central hole and lift your finished basin off its plaster mold.

ENLARGING OR REDUCING BY HAND

It frequently happens that after you have modelled a piece in a certain size you find that it is either too large or too small. There are professional enlargers who will "point-up" or "point-down" your work for you by machine. Such a process is quite expensive, but well worth while provided you have a definite commission and can afford it.

But most art students are poor and for them I suggest a method which they can use themselves, provided their enlarging does not extend to heroic scale. Suppose, for instance, that you have made a figure one foot high which, if enlarged to 3½ feet, would be good as a garden figure. Making it all over again "by eye" is curiously difficult. The enlargement *may* possibly turn out to be as good as the original, but the chances are that having expended your first enthusiasm on the small study, you cannot recapture the exact quality, or even the actual dimensions of the first sketch.

For a simple standing figure, which does not have to be enlarged with meticulous precision, and which has no very important depths that must be accurately measured, the double-ended calipers shown at the beginning of Chapter VI will serve perfectly well. But if the small study is a scale model, to be enlarged to very specific dimensions, another process should be used.

To measure these proportions accurately you will need two or three pairs of compasses of assorted sizes. The largest should open wide enough to measure the entire height of your enlarged figure.

Now either on your workbench, on a long wide plank, or on the wall, draw with a straightedge a horizontal line representing the total height the figure is to be when enlarged. We will call this line AB (Diagram 92). Now with a pair of compasses measure the total height of your small model. Holding this measurement carefully, place one leg, or point, of the compass at B and describe arc CC. Now, with the straightedge, draw line AD, exactly touching arc CC. This point we will call D.

Each compass measurement of the small model may then be transferred into its larger equivalent in the following manner: Firmly holding such a measurement with the pair of compasses (the two points of which we will call Y and Z), pass it back and forth with point Z hovering over line AB until an arc described by Y exactly touches line AD (first position in diagram). Now mark with a pencil the spot where Z rests on line AB. Then measure the distance from this pencil mark back to A (second position in diagram). This will give you the correct measurement for the enlarged figure.

By reversing this process you can reduce a large figure to a smaller size.

For determining the *depth in* of certain points in a more complicated group, one must of course be able to measure those three-dimensional points, as well as the vertical ones. For this, we draw an exact rectangle around the base of the small model, marking each corner with a tack driven in flush with the wood. On the board which is to support the larger group, a similar rectangle is drawn to scale and the corners marked with similar tacks. To ascertain where a given point lies within the imaginary "block" (the base of which is indicated by the rectangle), three pairs of compasses must be used and two people will be needed to handle them. Each of the pairs of compasses in turn measures from one of *three* corners of the smaller rectangle to the given point on the small model. Each such measurement is translated, by the method described above, into its enlarged counterpart, and the three pairs of compasses set on the three corresponding tacks at the corners of the large rectangle. The point above, where the upper ends of the three pairs of compasses exactly meet, will be the point you are trying to find.

Marble carvers usually use a similar method of measuring when they make a large carving from a small plaster sketch. Of course, by reversing the process, you can reduce a large figure to a small one in the same manner. This method of enlarging was used on

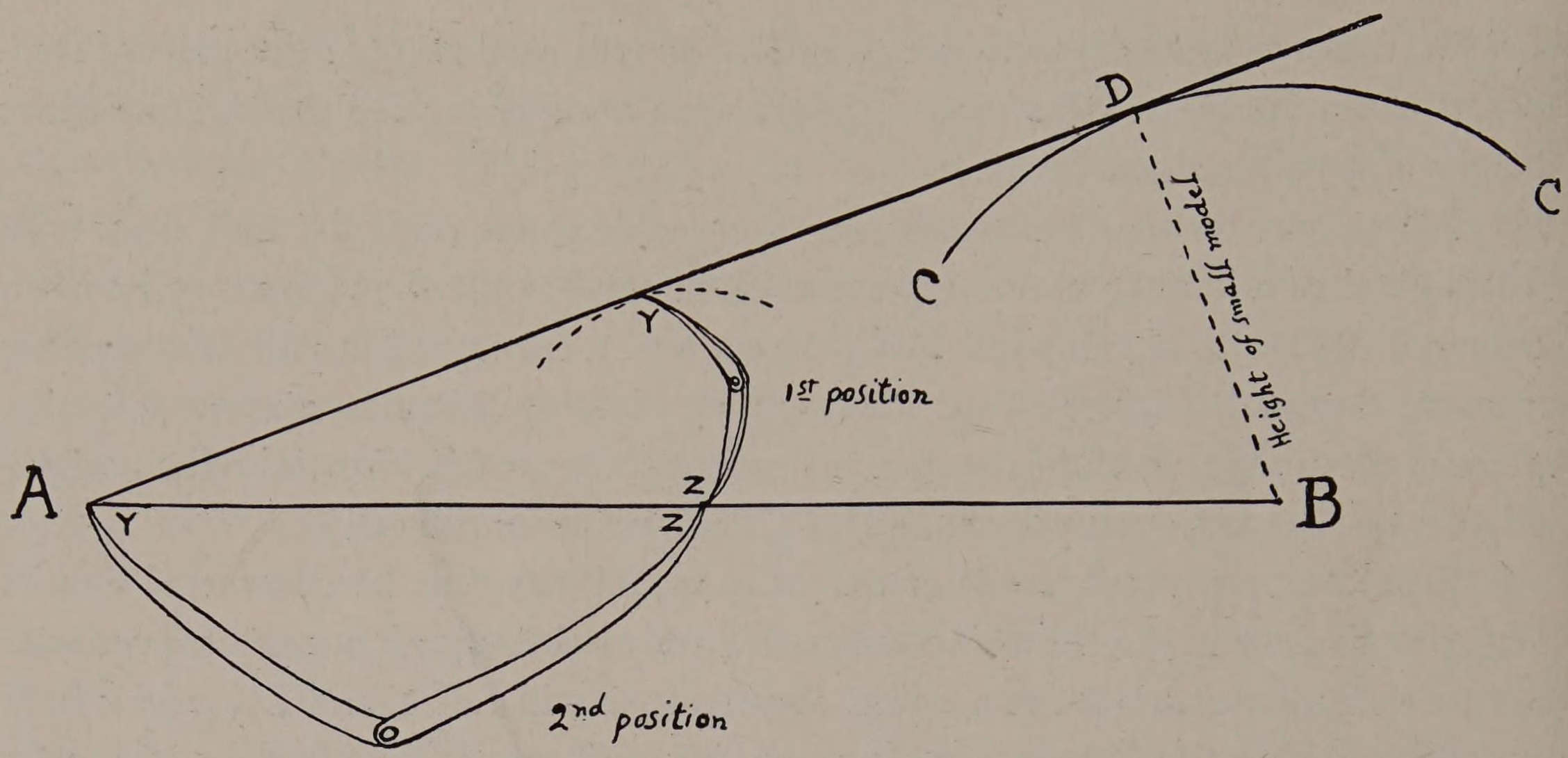


DIAGRAM 92

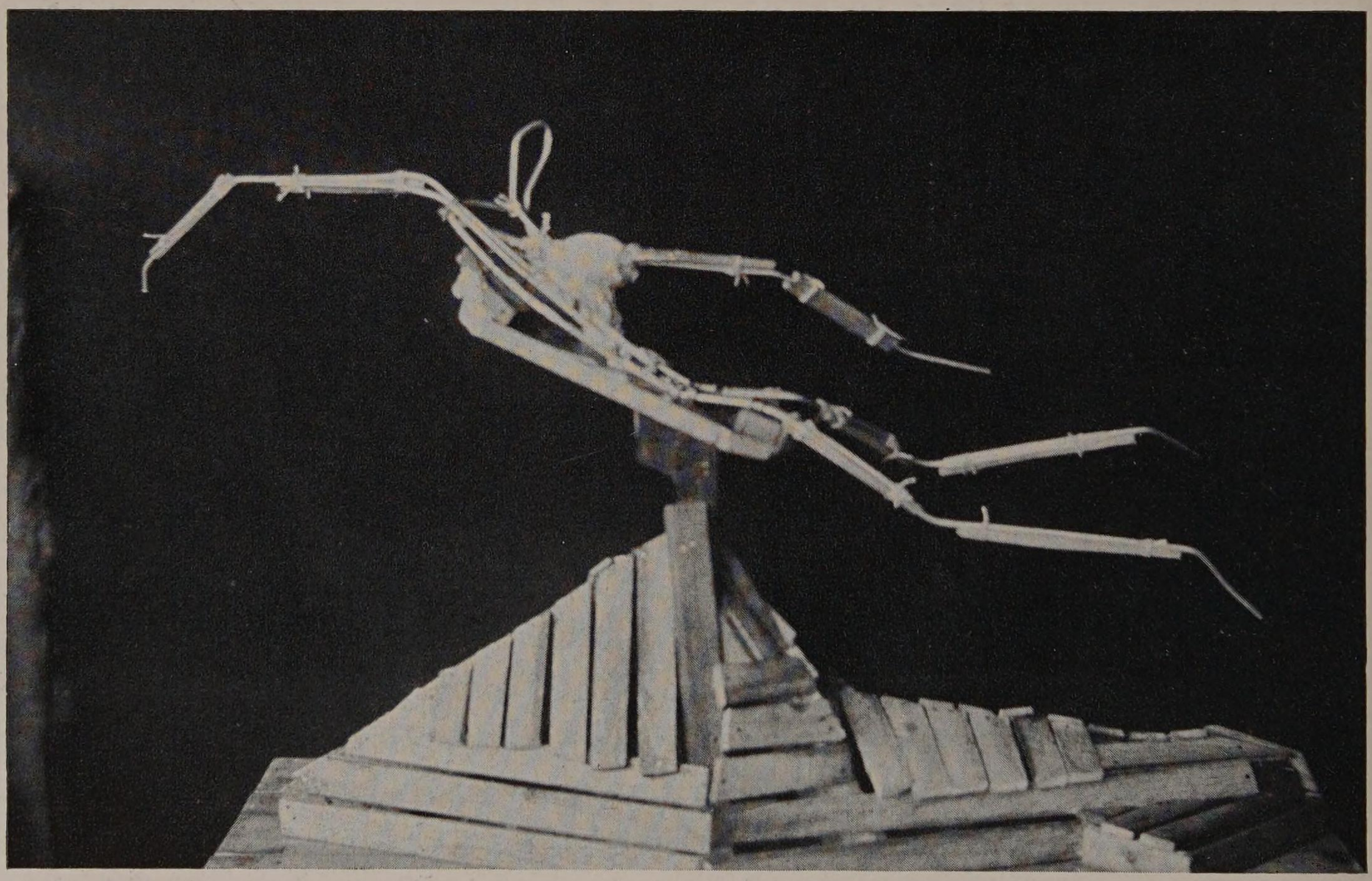


PLATE 157. Armature for Working Model of "The Crest." Brenda Putnam

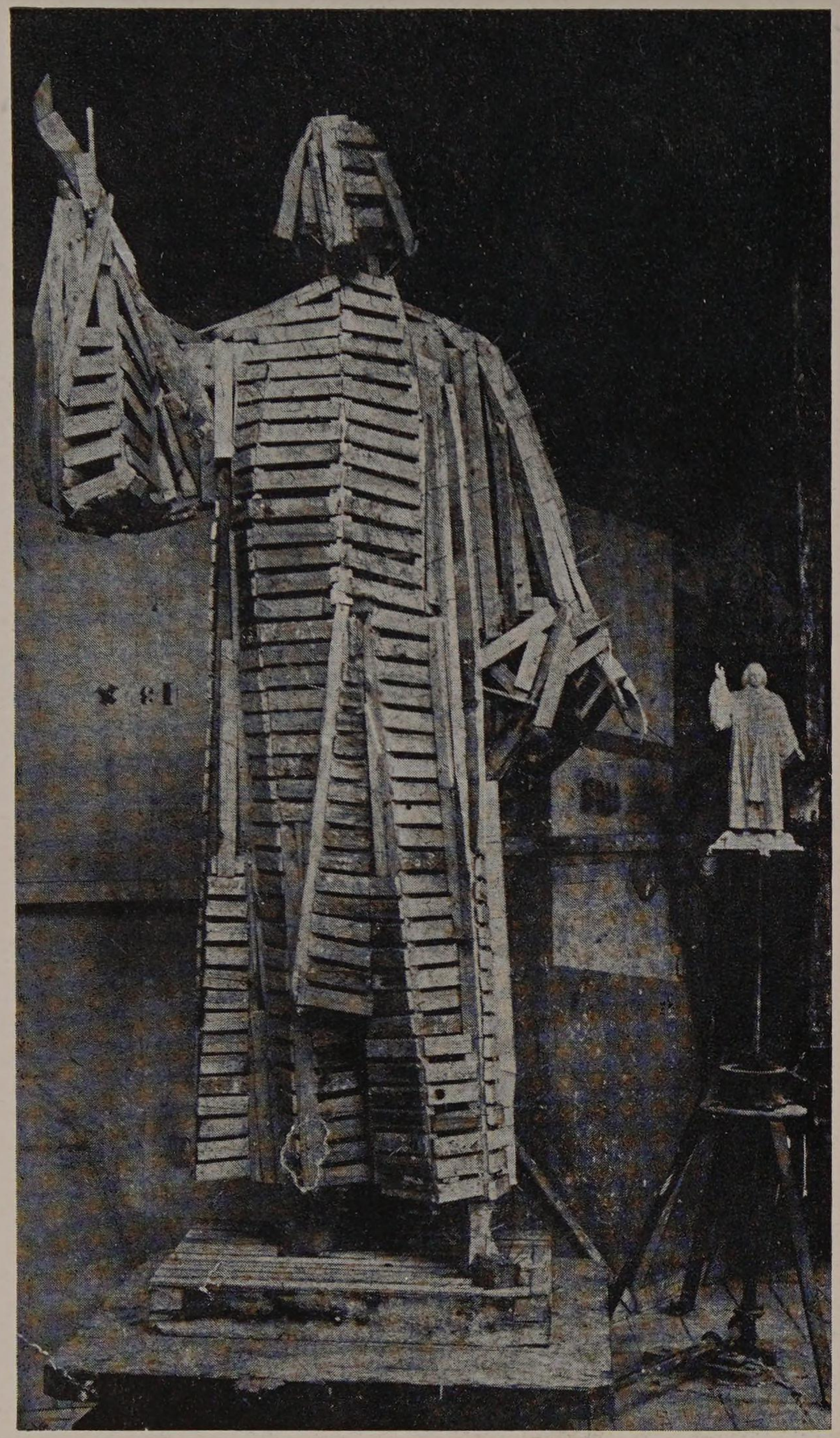


PLATE 158

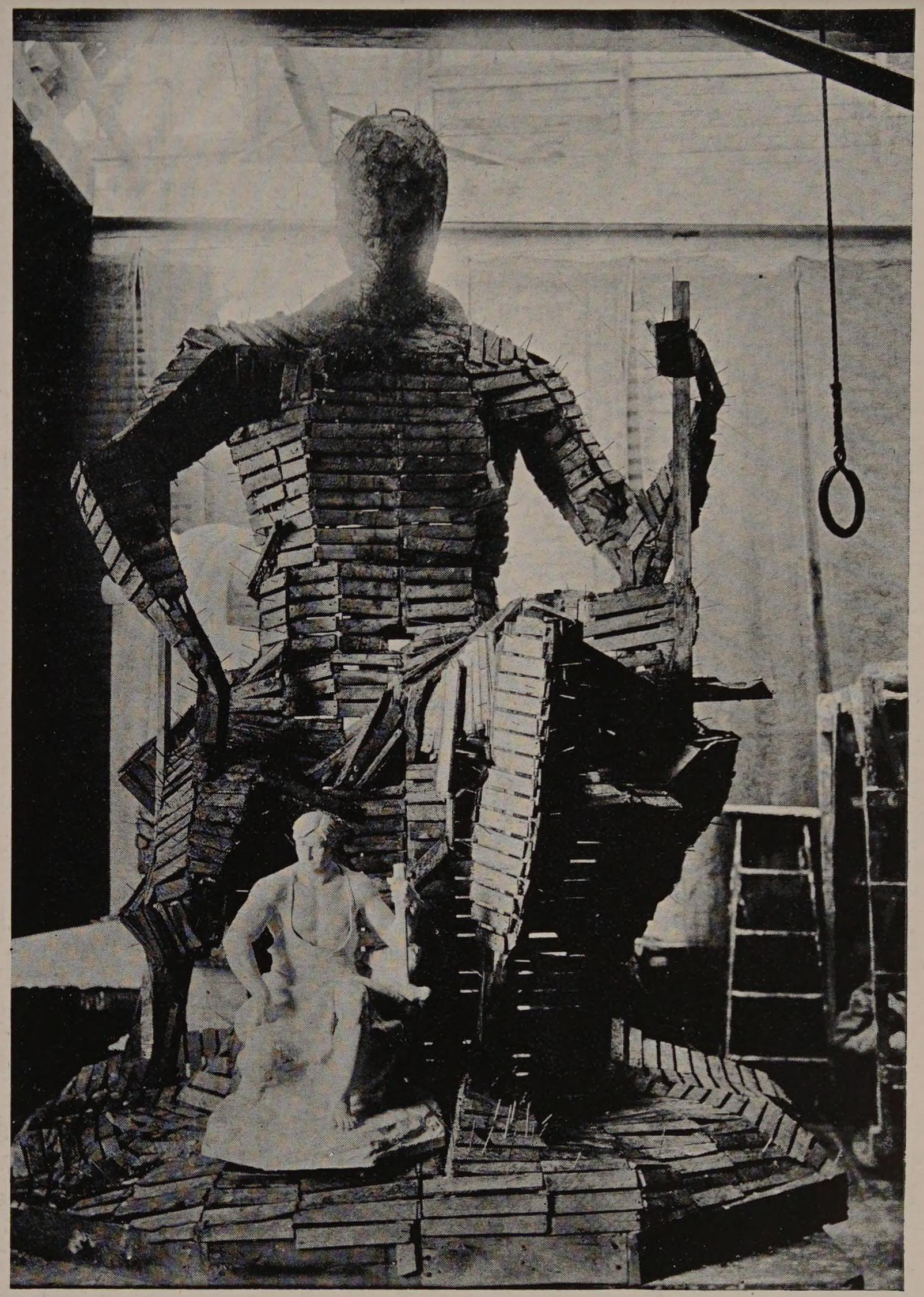


PLATE 159

Heroic Size Armatures, Enlargements by Ettl Studios, Inc. (Sculpture by J. O. Schweizer and Henry Hering)

a figure made by the author for the New York World's Fair. Plate 157 shows the weird-looking armature of the working model, which was enlarged to about four feet from a 1-inch scale model. Note that the entire horizontal body is supported by a vertical 2 by 4, with a slanting board nailed to the top of it. To this rigid support arms and legs of aluminum wire were attached. These limbs were further strengthened, except at the joints, with thin wooden laths tied on with string. Both to save plasteline and to lighten the weight of the whole mass, the wave below the "swimming" figure was built up out of similar laths.

In Albert Toft's book, *Modelling and Sculpture,* another method of enlarging by the "chassis" is described in detail. And in a recent and very fine book, *Modelling and Sculpture in the Making* by Sargeant Jagger, expert enlarging by means of a "pointing machine" is vividly described and illustrated.

Briefly, the process is as follows: The two stands, holding model and enlargement, are immovably fastened to the floor. Between the two, just above the floor, runs a connecting rod, so adjusted that the tops of both stands revolve at the same time. The pointing machine, in essence a pantograph, is set up before them. On an immovable upright, a movable horizontal rod swings on ball bearings. To this rod are attached two needles, one longer than the other. While the shorter measures a point on the small model, the longer synchronously measures a corresponding point on the larger armature.

Plates 158 and 159 show heroic-size armatures, built by Ettl, a professional enlarger. Over a wooden frame, slats shape the major forms of the figures. Over these slats a layer of clay, plasteline, or plaster will be packed, a few inches deep. In the picture of the seated figure (by Henry Hering), you will note countless nails projecting from the wood like pins in a pincushion. Each nail represents a measurement taken by the enlarging machine; each nail will eventually lie just below the surface of the modelled figure.

LIFE MASKS AND DEATH MASKS

As this chapter concerns itself mostly with mechanical processes, it may be well here to say something about plaster casts made directly from the living, or dead, model. Although such casts can hardly be called "art," they may on occasion, prove of great assistance to the artist. A death mask, for instance, may be very useful to the sculptor who has the unfortunate task of making a posthumous portrait. Flesh forms, to be sure, will not be quite as they were in life, for they naturally drop away from the ridge of the face, but the bony construction under them will be a valuable asset to the sculptor.

In making either life or death masks, the hair of the head should be carefully covered with a tightly wrapped cloth, for it cannot be cast. Eyebrows and eyelashes must be thickly smeared with grease or vaseline before the plaster is applied, and all the skin with a thinner layer, too. Nostrils and ears should be stopped with cotton, or they will form undercuts which will catch in the mold. In the case of a living model, quills wrapped in cotton are inserted in the nose, to enable the sitter to breathe. Although the ears are not to be cast, plaster is almost sure to run into them as the sitter lies with his head back, unless they are filled with cotton.

Life masks, indeed, are a definite peril to the sitter and should *never* be undertaken by the inexperienced. The poor victim may be scarred for life if things go wrong. Even by using the greatest care with grease, quills and little pads over the eyes to protect them from the plaster, the sculptor invariably causes acute discomfort to his sitter as the latter feels the heavy hot plaster stiffening and imprisoning his face and throat in a tight grip. Indeed, the model may well find the ordeal unbearable and give one convulsive gasp just as the plaster is about to be removed, thus shattering the mold and ruining the whole business.

Casts of hands are safer, though even they are not too comfortable for the sitter. The best way to make them is as follows: After greasing the hand, mix some plaster fairly thick and pour a heaping quantity of it on a board. Allow it to stand for a moment, then have the sitter lay his greased hand down on the plaster "bed" just heavily enough so that the lower half of palm and fingers is imbedded in the plaster. Decide beforehand just what pose you wish his hand to assume, and make him hold it there without moving until the plaster sets. Salt added to the water will make the plaster set quicker.

After the plaster has set, the sitter removes his hand from this bottom mold. It should then be soaped like any other mold. After this is done, the sitter replaces his hand in the mold, and more plaster is poured or painted over the upper surface of it to make the other half of the mold. When this has set, the two molds are pried apart, and the sitter's hand set free.

There is a grimly humorous, if somewhat apocryphal, anecdote about making a death mask which will, I hope, bring vividly to your consciousness the difficulties of the job. The story was told by a sculptor now residing in America, but who was born and had his early training in one of the smaller countries of Europe.

It seems that while this young man was a student at the art academy, the prime minister of the country died. Pending the impressive state funeral, during which the

body of the prime minister was to be borne through the streets of the city, it lay in state on a high catafalque in the great cathedral. Not until two hours before the ceremony, was it decided to have a death mask made of the deceased. A frantic search for an expert caster proved fruitless, so finally the academy was consulted. Was there any student in the modelling class who knew how to make a death mask? The author of this story brashly volunteered, although he had never done such a thing before. Commandeering a still younger student to act as assistant, he hastily gathered up some materials—plaster, pails, brushes, scissors, etc.—and the two sped to the cathedral. There they were admitted by the sacristan, whom they summarily dismissed, saying they must work in absolute privacy. Bolting the great doors against the populace, who were already gathering in the square outside, and climbing a hastily improvised scaffolding of tables and chairs, they caught their first sight of the distinguished man. Horrors! He had a luxuriant black beard. No time to worry or consult further. The mold must be made now or never.

Taking stock of their materials, they discovered that by mistake they had brought the gluepot instead of the greasepot. No time to go back for it. Mixing plaster, the young sculptors smeared it thickly over the august visage. When it had set, their first attempts to pry it off were unsuccessful; it would not come off. Finally, in despair the two boys climbed up on the dead man's chest, and by hauling with might and main, finally succeeded in yanking off the mask.

But with it, firmly imbedded in the thick plaster, came the luxuriant black beard! *What* to do? By this time the hour for the funeral had arrived and the sacristan was pounding at the door, demanding entrance. The students stared at each other in utter dismay. Then the elder, gazing at his companion, a youth with long raven locks, had an inspiration. With swift strokes of the shears, he ruthlessly snipped off those raven locks, and with the heretofore useless glue, he fashioned a new beard on the face of the prime minister.

Then, hastily cleaning up the mess they had made and gathering up their materials, they unbolted the doors and fled from the scene. All afternoon, as a drenching rain fell, they cowered in the schoolroom, hearts in mouth, wondering if the rain were melting off the improvised beard as the prime minister was borne through the streets. But as the hours passed and no disquieting rumors reached their ears, they at length breathed freely, knowing that by this time the great man must be safely underground, taking their secret with him.

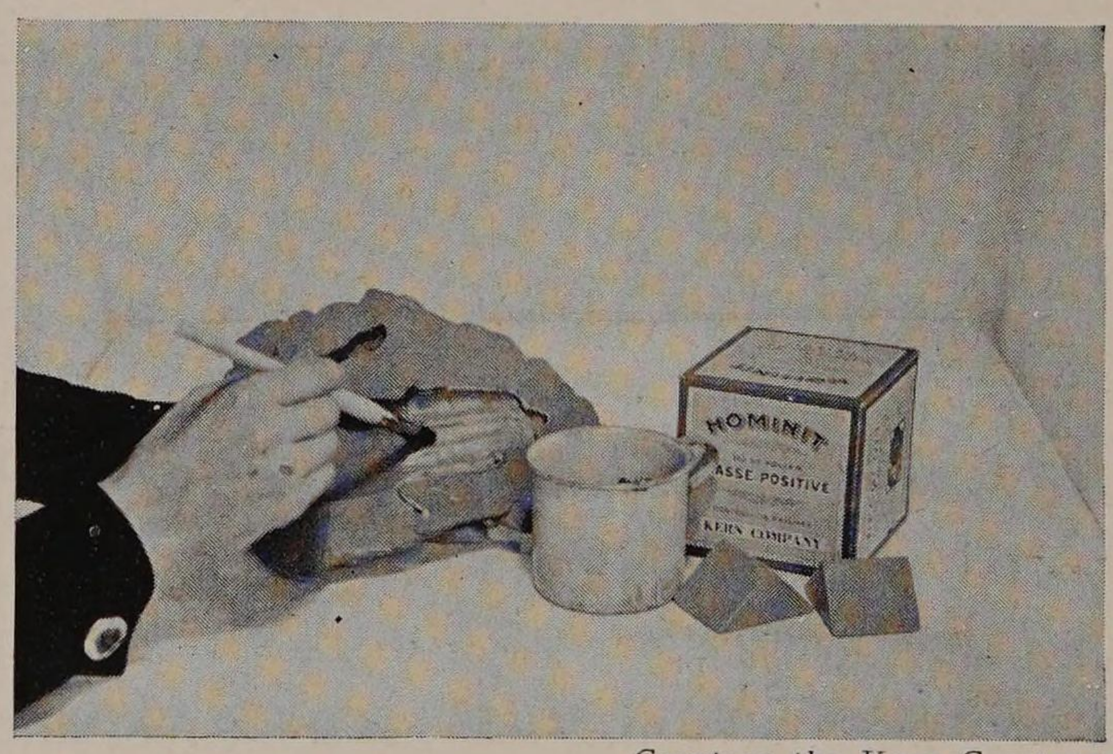
NEW MATERIALS FOR MOLD-MAKING

Negocoll, a quite recent invention imported from Switzerland, has certain advantages over plaster. The gelatinous stuff is boiled down in water and, when lukewarm, may be painted over the face or hand. Being rubbery in consistency, it can be removed in one piece, even though there may be some undercuts in the object. It is pleasanter for the victim, as it is both lighter and less rigid than plaster and, even if left on for some time, causes no constriction of skin and muscles. Another advantage is that the sitter's skin need not be previously greased, and the resultant mold and cast are extremely clear.



Courtesy the Kern Company

PLATE 160. Negocoll



Courtesy the Kern Company

PLATE 161. Hominit

Dr. Poller, who invented Negocoll, also invented Hominit, a resinous material with which very light, thin casts can be made from Negocoll molds (Plates 160 and 161). This also is used while hot. I, myself, have found some difficulty in painting it evenly into the mold, as it sets almost immediately on touching the mold, and even on a comparatively small area the first few brush strokes are apt to cool and harden before the next can be applied, thus making separation marks in the cast. But no doubt much practice would overcome this drawback.

A certain advantage of Negocoll is that while the initial cost is fairly high, the material can be used over and over again, requiring only to be chopped up and boiled anew. This boiling, by the way, is a fairly long and tedious process. It must be done in a double boiler, over a low flame, and stirred for at least one hour before the material is free from lumps and ready for use; then it must cool almost twenty minutes before it

is applied to living tissues, though of course this cooling is not necessary if you are casting some inanimate object.

I found that, when making a two-piece mold with Negocoll, there was considerable difficulty in making the two meet closely along the inner seam. One can pound the two sections of a *plaster* mold together until the seam fits closely, but Negocoll is both resilient and fragile. It cannot be rammed down and, even when firmly tied, it tends to separate when the hot Hominit is poured in, thus making a wide seam and distorting the form of the cast.

All in all, there seem at present almost as many drawbacks to Negocoll and Hominit as there are to plaster. Undoubtedly further experimentation may overcome some of them but, as they are now, they are more valuable to the surgeon or dentist than to the sculptor. If you should, through experiments, make any discoveries which would lead to its improvement for sculptural purposes, I am sure the manufacturers would be glad to hear from you.

Experiments have also been made recently with *rubber* molds. These have some advantage over the usual *glue* molds used by casters, and are quite widely used for manifold castings of small commercial objects. But like gelatin, rubber molds also deteriorate after a while.

Latex has been used with more success, as it neither shrinks nor warps with repeated use. Like Negocoll, it is painted onto the surface, rather than poured into a shell, like gelatin. But it cannot be broken up and used over again, so it is still too expensive a medium for widespread use. But you will find that it makes an extremely fine, sensitive mold, reproducing every minute detail in small plaques.

Plastics are still very much in an experimental stage, but they have already been used by sculptors, especially as bases for portrait heads, etc. One can order blocks in any shape, size, or color. It is also possible to carve in plastics, which rather resemble soapstone in texture. The material is slightly resilient, and practically unbreakable, and is unaffected by weather if used for decorative motifs out of doors.

Undoubtedly more discoveries along these lines will soon be made, and the wise sculptor will keep himself informed of all the new possibilities offered by our research chemists.

CHAPTER XII

CERAMIC SCULPTURE

Carl Walters

THE PREPARATION OF THE CLAY

GREECE credits Vulcan with making Pandora, the first mortal woman, out of clay. Later, Keramos, the son of Bacchus and Ariadne, became the patron saint of pottery, from which we obtain the word ceramic, or keramic.

Terra cotta, or baked clay, was one of the first mediums that man used for artistic expression, for one of its great advantages is that after being fired it becomes one of the most durable of substances; another is its great range of possibilities in color, both in the terra cotta itself and by the application of colored glazes.

Since clay is the chief and most important material used by the ceramic artist, it is advisable that the beginner should have some knowledge of its properties and preparation. Natural clays range from pure white and infusible kaolin, containing only alumina and silica, with a small percentage of alkalis, to the impure gray, red or brown clays, containing, besides the alumina and silica, magnesia, potash, soda, iron, lime and carbon. Kaolin is used with china clay (a combination of feldspar and quartz) to make porcelain, the finest and hardest paste known to ceramists, and the one which has the highest firing point—around 1500° Centigrade.

From this there are many gradations, through soft porcelain and several degrees of earthenware, to where the presence of lime or iron colors the clay and makes it easily fusible, so that much heat turns it black and collapses it to slag.

For successful ceramics three properties are necessary in a clay: First, plasticity, for without this, clay could not be shaped; second, porosity, because a clay which has a high degree of plasticity alone cannot be safely dried, the water cannot escape

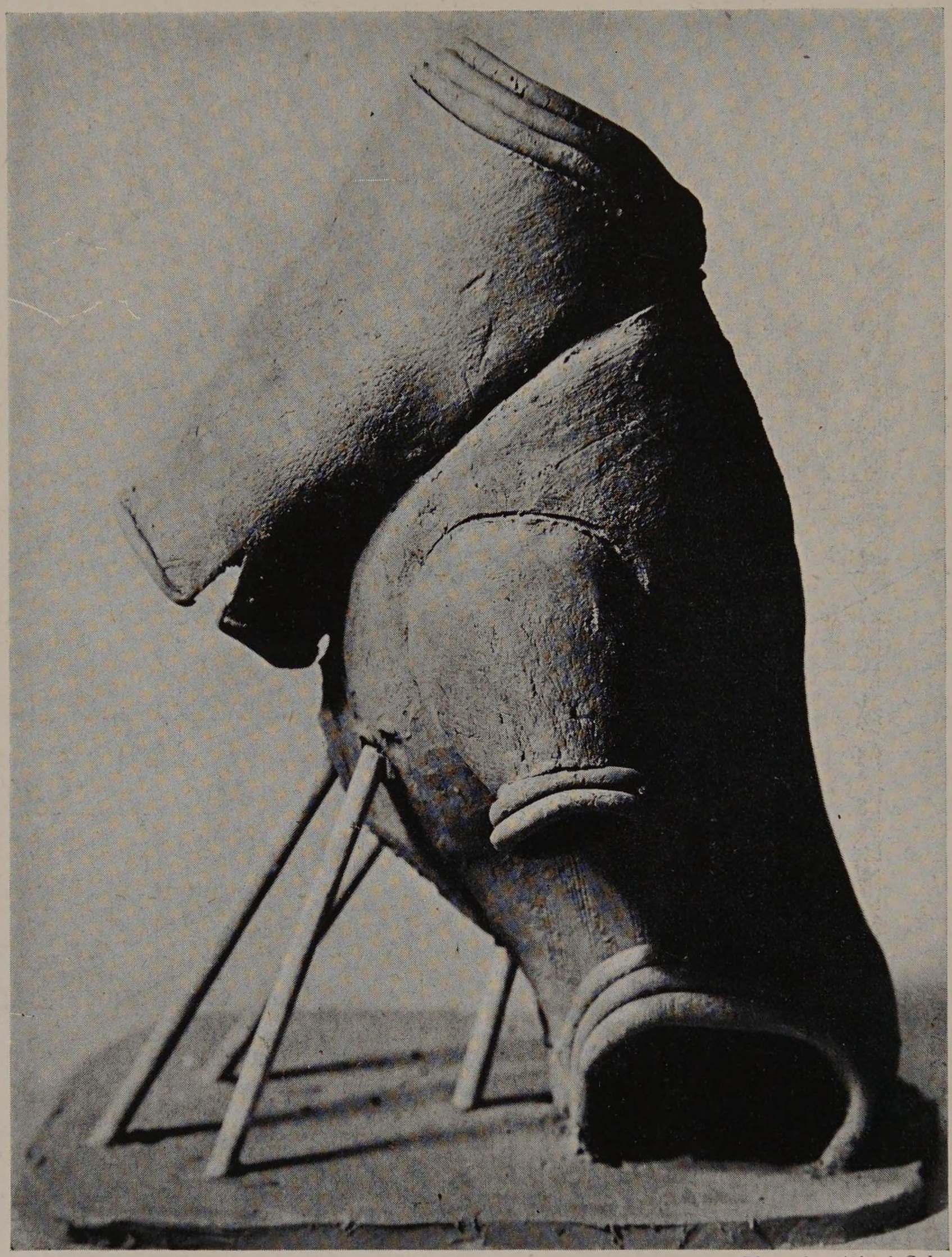
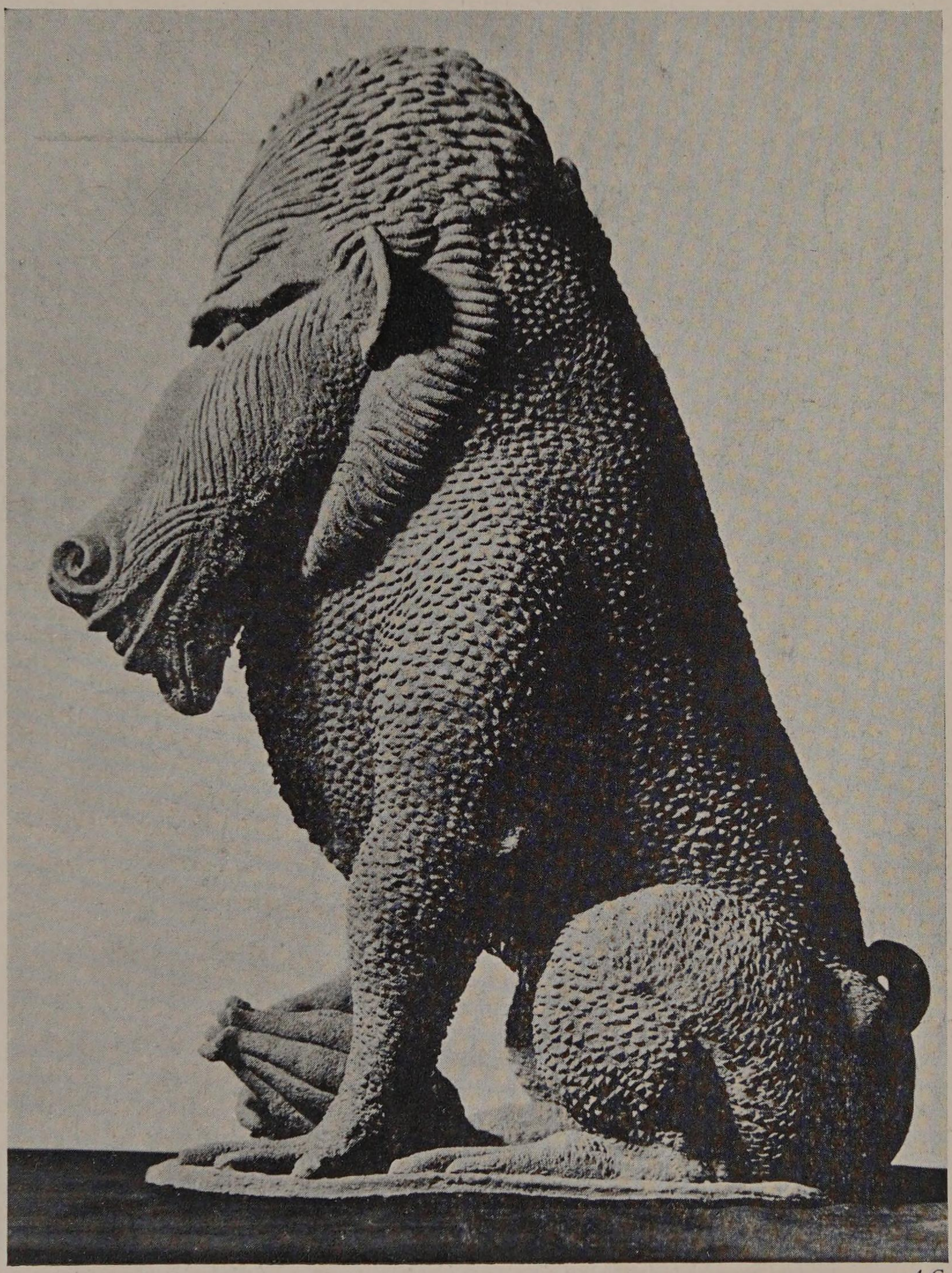


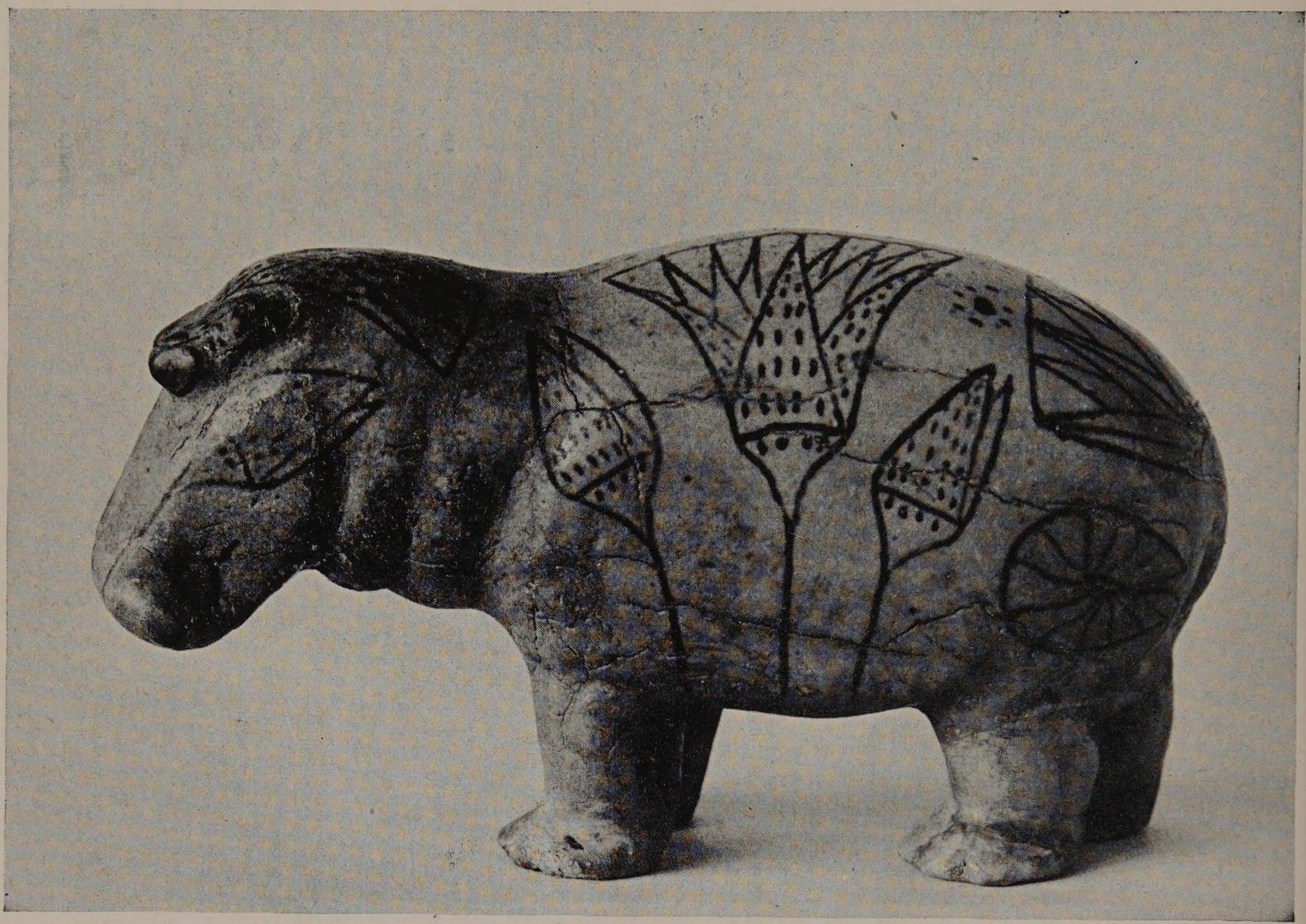
Photo by Alfred Cohn

PLATE 162. Mandrill, First Stage, *Clay*. Carl Walters



A.C.

PLATE 163. Mandrill, Final Stage. Carl Walters



Courtesy Metropolitan Museum of Art

PLATE 164. "William, the Hippo," *Glazed Terracotta.* Egyptian, 12th Dynasty

and therefore the clay warps and cracks. A porous clay permits the water to escape and it can be safely dried. This condition is produced by adding sand, or by the presence of sand in natural clay. Too coarse a sand will interfere with the delicate working, while too fine a sand will produce too dense a mixture. Porosity is the opposite of plasticity, the two properties must be adjusted so as to balance each other. The third essential property is vitrification—the property which causes the clay to flux in the fire and is due, principally, to the addition of feldspar. Here also there is need for adjustment, according to the density desired. The more feldspar a clay contains, the lower the temperature required to vitrify it and the denser the body.

Many artists will want to test clays they have found, to see if they are suitable for their use, and whether they will have a durable body and a good color. Also it is often more satisfactory and much more economical to prepare your own clay than to depend upon buying it.

Should a deposit of clay be found, carefully weigh out a hundred grams of dried clay and crush it to a fine powder on a piece of plate glass. Fill a graduate holding 100 cubic centimeters with water, adding a little at a time to the clay until it is worked into a pliable condition. The quantity of water used is then carefully noted by observing how much is left in the graduate. If the clay being tested has taken approximately 40 cubic centimeters, it is fairly certain to be a usable clay. If it has absorbed only about 25 cubic centimeters, or less, it will not be very plastic and probably only good for making bricks.

The next step is to ascertain how the clay acts in the fire. It is advisable, for the greatest success, to have a furnace of your own, but if that is impossible, it will be necessary to find a kiln that can be used.

Roll out the clay that is being tested, about three-quarters of an inch thick, on a piece of canvas. Cut out three small squares or oblongs, scratch on them the temperature at which they are to be fired, the source of the clay and any other data you may need for future reference. If possible, have the three pieces fired at different temperatures with sufficient range to get an idea of the degree of heat at which the clay matures. Dry thoroughly, start with a low fire and gradually increase until the desired temperature is reached. Touching the tongue to the sample is a fair test of density. If the tongue sticks easily, the body is too fragile, but if the absorption is slow, the body should be hard and durable.

If a clay has been found to have all the necessary requirements except color, alterations may be made either by mixing various colored clays, or by adding powdered earth colors, such as light red, yellow ocher, burnt sienna, etc., all of which can be procured at any paint shop. Burnt sienna added to ball clay will burn to a pleasant buff. Light red added to that will give a slight reddish tint. Light red added to ball clay will produce a warm pink, and so on. It is advisable to weigh both clay and color in the dry state, and to make a note of it, so that you will be able to repeat.

Before commencing actual work on any scale, many experiments with different clays should be carried out—with notes on all trials. Fusible clays are apt to buckle and turn a disagreeable color in a high fire, while refractory clays are apt to break. The addition of flint, or quartz sand, or refractory china clay, will stiffen up clays apt to warp; while fusible clays added to refractory clays will lower the fusing point; the same effect may be achieved by the addition of feldspar. Stiff sandy clay will need finer sieving or more washing to get rid of the sand.

Earthenware includes all opaque bodies differing from porcelain, whether white or colored. A body made of a natural red clay is often and properly called terra cotta, but may with equal correctness be called earthenware. Earthenware bodies have unlimited variations, ranging from 50 to 60 per cent clay substances, 32 to 38 per cent quartz sand, 8 to 10 per cent feldspar. Earthenware will be creamy in color and porous at an ordinary fire. A good formula to make a fusible clay retain its shape is to use 80 per cent red burning clay, 10 per cent china clay and 10 per cent flint.

The tests having been completed, it will be necessary to prepare a quantity of clay for use. A fairly large amount should be obtained and stored in a dry place. Most natural clays will need cleaning, as there will usually be roots, twigs, etc., present. This is done by reducing the clay to what is known as *slip*. The equipment necessary for this is: a large sieve (quarter-inch mesh); a small sieve (about fourteen meshes to the inch); a stout barrel; two galvanized buckets; a good-sized mallet; a strong canvas bag.

After the clay is thoroughly dried, put it in the bag and reduce it to a fine powder by stamping on it and pounding it with the mallet. Fill one of the buckets half full of clean water and sprinkle the powdered clay through the quarter-inch sieve, handful by handful, on it. The clay rapidly absorbs the water and sinks to the bottom. Continue *without stirring* until a small mound rises through the water; the clay should then be left to soak for an hour. While one bucket is settling, the other can be filled. Then stir vigorously with a flat stick, or the arm. The arm is better, as the hand can tell a great deal by the feel of the clay. After stirring, pour through the finer sieve into the barrel until a good quantity of slip has been prepared.

At this stage it is well to make any additions of sand or feldspar that have been decided upon, although these can be made when the clay is in the dry state.

Allow the barrel of slip to stand overnight, when the clear water may be siphoned off the top. This should be repeated until the slip has reached the consistency of heavy cream. After a thorough stirring it is then in the best condition for pouring in molds. This process is described in a later paragraph.

The slip will keep indefinitely if an inch or two of water remains on top, so that it cannot dry out; for this reason, it is well to have a tight-fitting cover for the barrel. Wet clay greatly improves with age. It is composed of an infinite number of microscopic laminated crystals, which, when wet, are held together by molecular attraction; and, when it is stored over a period of time in a damp dark place, the vegetable matter

lying between the crystals is decomposed by bacterial action, thereby allowing the crystals to lie closer together and so making the clay more plastic.

To stiffen the slip into a workable condition for modelling, it should first be well stirred, so that all the heavier ingredients will be equally distributed, and then poured onto large thick plaster bats, slightly hollowed like a platter. When enough water has been absorbed by the plaster to leave the clay in a plastic condition, it is ready for wedging.

Wedging is important, for if any air bubbles remain in the clay, they will expand during the firing and are apt to cause the piece to explode.

A good strong bench should be built, the top, if possible, being of four-inch plank and measuring about eighteen by thirty inches. Fix a twelve-inch post firmly to the back of the bench and a three-inch peg to the front, then stretch an eighteen-gauge brass wire on the diagonal between them. It is a good idea to spread canvas over the bench, tacking it down on the two ends of the bench. This will facilitate lifting the clay. One side of the bench may then be reserved for wedging red burning clay and the other for white. In this way it is easier to keep the clay clean.

Take a ball of clay in both hands and cut it in two against the wire, then slap it smartly on the bench, one piece on top of the other. Give the clay a slight roll to create a rounded surface on the bottom, cut it again on the wire, slap the two rounded surfaces together (to expel the air) and proceed as before, repeating a sufficient number of times to insure a smooth uniform texture. This can be judged by pinching a piece between the fingers to see if it is blended and not hard and soft in streaks.

For storing prepared clay, large earthenware jars make excellent containers, but they should be fitted with metal covers, since the earthenware covers are unwieldy and easily broken. If the clay is supported a little from the bottom of the jar, an inch or so of water can be kept in it and will help keep the clay from drying out so rapidly.

These processes are certainly tedious, but the results will repay the experimenter amply; with familiarity the technique becomes second nature.

MODELLING

In modelling ceramic sculpture either one of two processes may be used. If the artist intends to make more than one figure, he may proceed by building up the form with clay or plasticine on an armature in the usual manner, and then having a plaster of Paris piece mold made from the original. The other method is for one piece only,

where it is not intended to reproduce it and the artist is willing to risk his original to the fire. In this case an armature cannot be used, as the clay shrinks in the drying, while the armature does not, and the result would be a series of cracks and the falling away of the clay. It is advisable, therefore, to make a hollow figure, unless it is very small, as a solid figure is difficult to dry, and in firing it may still contain moisture and cause an explosion.

There are two methods for making a hollow figure; either building up by coils, as the Indians of the Southwest make their pottery, or by using clay cylinders to create a rough form, then building on them with coils.

As an example, the figure in Plate 162 was made by rolling out a sheet of clay on canvas (so that the under surface would not adhere) and, when the clay was slightly stiffened, making it a self-supporting cylinder by tapering the two edges that were to be lapped, moistening them with slip and pressing them well together. The cylinder was then stood on end and shaped into somewhat the desired form by pressing together and extending from inside. This was then set at approximately a 45° angle, supported with dowelings (round sticks), on a clay base to which it was welded with clay and slip. A smaller cylinder was formed in the same manner for the head and joined by cutting an opening the size and reverse outline of the neck and pressing together, using slip to assure a good contact. The legs and head were then completed with ropes of clay, again using slip between the coils to weld them together.

When clay is added, the contacting surfaces should be moistened and the whole figure should be sprayed occasionally. Care should be taken not to spray too often or too energetically, as the clay may become too soft and collapse.

CASTING

Naturally, if you fire a terra-cotta piece, it remains your only copy (a "unique") unless you make a plaster piece mold of it, from which a number of copies may be reproduced.

If the figure is to be cast, it is an advantage to start with a simple form, at first avoiding undercuts, so that it can be cast in a two- or three-piece mold; then it will be possible to do your own casting, unless of course you prefer to leave it to a professional caster. When simple molds have been conquered, more complicated ones can be tackled. If the figure has projections, such as ears, etc., they may be left off when being cast and added to the figure after it is released from the mold, as may any other details.

A two-piece mold is simplest for the beginner. The figure should be so modelled that it can be divided into two sections, without undercuts.

Divide the figure with thin pieces of brass or tin, shaped like wedges with the long points cut off. Oil and insert these pieces in a line, starting with the head and down the two sides, allowing each piece of metal to lap the next slightly.

The plaster of Paris, for making the mold, should be prepared in an enamel or a rubber bowl. Fill the bowl two-thirds full with water and slowly sprinkle the plaster through the fingers until the water has been nearly soaked up. Stir until it thickens to the consistency of heavy cream, then, with your hand, throw it against one side of the divided figure until the plaster is built up to the thickness of about an inch. Remove the metal wedges and carve a number of sockets on the exposed surface. Then cover the surface with liquid soap or oil to prevent the next half of the mold from sticking and proceed as before. When the plaster has set, thin wedges can be driven in the joint and the mold can be separated. If there is clay adhering, the inside should be washed out with a sponge. The mold should then be tied together and left to dry.

Slip, the consistency of thick cream, is then poured through the opening in the bottom of the mold until it is filled. As the water is absorbed from the slip by the plaster, a layer of clay will be formed and, as the slip sinks, more should be added, keeping the mold level full. From time to time, scrape away with a knife from the top of the mold to determine the thickness of the wall. When the wall has thickened to about three-eighths of an inch, all the remaining slip should be poured out and the mold stood in an inverted position. When the clay in the mold has toughened a little, it should be cut loose from the edge to the depth of about an eighth of an inch. With further drying the figure will shrink away from the mold and may be released. The seams should be smoothed out with a modelling tool, the surface retouched, if necessary, and left to dry.

Reproductions can also be made in the piece mold by rolling out a sheet of clay on canvas, as previously described, and pressing the smooth surface into the two halves of the mold. The edges should be trimmed, allowing about one-eighth of an inch projection all around, then moistened with slip and the two halves pressed firmly together. The seams should be further worked together by pressing with a tool from the inside. A pressed figure will shrink less in drying than a cast one and can be taken from the mold in a much shorter time.

To keep work damp overnight, for a small figure a rectangular frame can be made and covered with rubber sheeting, as the weight of wet cloths sometimes leaves an imprint. For larger pieces the best arrangement is a damp box, which is a zinc-lined box with a tight-fitting cover, in which are kept wet plaster bats to keep it moist.

Ceramic figures, like stone, should be kept free from delicate projections which are apt to be broken off. If the piece is to be glazed, sharp edges should be avoided, as the glaze has a tendency to flow away from them. Most of the modelling can be done with the fingers and one or two good tools. When leather-hard it can be carved with a knife or a plaster tool.

FIRING

Kilns are of two kinds, open and muffle, and vary in their construction, depending upon the fuel used. The first kilns naturally were for wood, but when coal was discovered the wood-burning kilns were rapidly displaced; now gas, oil and electric furnaces are used almost exclusively.

Terra cotta can be fired in any type of kiln, but glazed pieces should either be fired in saggers, if an open kiln is used, or in a muffle kiln, which is an enclosed oven which allows the flames to play on all sides, without coming in contact with the contents. The most practical type of kiln for an individual who is doing his own firing, is a muffle kiln, or, better yet, an electric one. The electric kiln, although more expensive, is simpler to manage and has an automatic pyrometer that can be set for a desired temperature. Seger cones are generally used in small, nonelectric kilns to determine the temperature.

After the figure has been placed in the furnace on a stilt or on pieces of firebrick, so that the heat can circulate underneath as well as around all sides, and the Seger cones placed where they can be seen from the spy-hole, the fire should be applied gradually, as clay retains some moisture always, even though it may have been drying over a long period. This moisture must be expelled slowly, as otherwise the steam generated will cause the figure to explode. The size of the figure and the thickness of the walls will determine the length of time necessary for this slow fire. A small piece can be brought up fairly rapidly, but that must be learned by experience. Most ordinary clays mature in the firing at a temperature between 1000° and 1040° Centigrade, or 05, 04, 03 Seger cones. The ends of these cones should be embedded at an angle in a small strip of clay to which a large quantity of sand has been added. When the cone has bent over in the form of an arch, the fire may be shut off and the kiln left to cool.



Courtesy Metropolitan Museum of Art

PLATE 165. Camel, *Glazed Terracotta.* Early Chinese

GLAZING

Glazes offer the sculptor many possibilities in color and design. The important types of glazes are: alkaline glaze, used by the Egyptians and Persians, the oldest and most difficult; lead glaze, used for most ordinary purposes; feldspathic glaze, used for high fire porcelains; salt glaze, produced by throwing salt on the floor of the kiln, which vaporizes and combines with the silica in the clay, forming glass used for most chemical containers, common tiling and stoneware.

It is possible to purchase glazes ready for use, but it is more satisfactory to prepare your own from raw materials and therefore obtain a greater knowledge of ceramics.

The most commonly used ingredients of colorless glazes are: sand, flint, fluor spar,



A.C.

PLATE 166. "Playful Piebald," *Glazed Terracotta.* Carl Walters

feldspar, kaolin, Cornish stone, bismuth, gypsum, limestone, niter, bone ash, borax, barytes, red lead, white lead, tin oxide, zinc oxide, salt, potash, soda.

For color, different metallic oxides are used, as: cobalt, for blue; copper, for blue, green and red; chrome, for green; iron, for yellow, brown and green; nickel, for gray and brown; uranium, for yellow; manganese, for purple; tin oxide, for opaque glaze, white or colored.

Soluble ingredients, such as soda, potash, borax, etc., are not commonly used in raw glazes, but must be fritted; that is, fused in a crucible or fritting furnace. Lead is the principal flux used in raw glazes.

Fitting the glaze to the body can only be achieved by experiment, although occasionally one has luck and it fits at the first trial. If the glaze crazes, that is, develops minute cracks all over the surface, it may be due to over-firing or under-firing, but if



Courtesy Metropolitan Museum of Art

PLATE 167. Horse's Head, *Baked Clay*. Early Chinese

A.C.

PLATE 168. The Cub, *Baked Clay*. Carl Walters

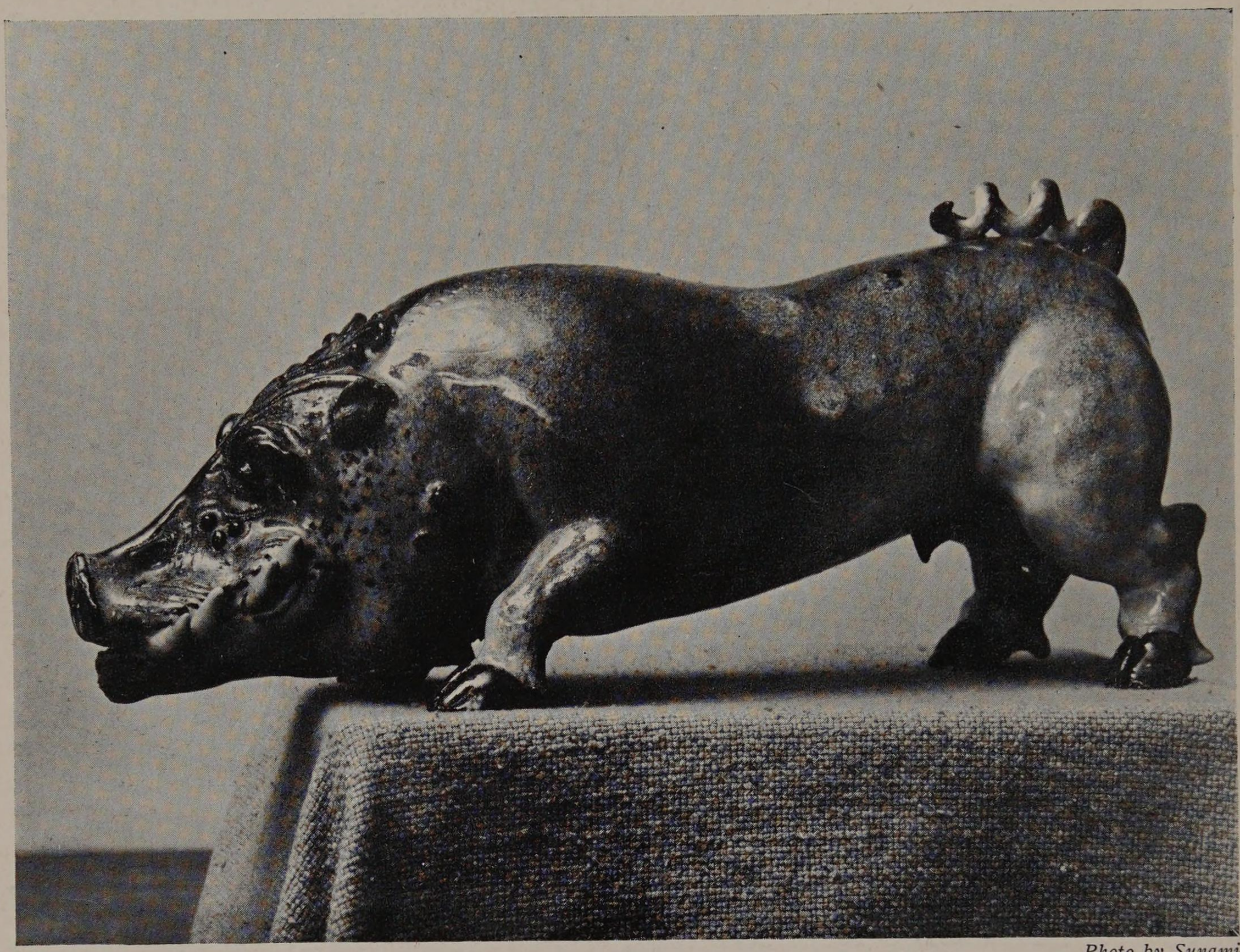


Photo by Sunami

PLATE 169. The Wart Hog, *Glazed Terracotta.* Carl Walters

that is not the case it is evident that there is an inherent disagreement in expansion, which can be cured by the addition of flint to either the glaze or the body. It is best to add it to the body if possible, so as not to raise the firing point of the glaze. If the craze is not too deleterious it is sometimes not a detriment. The Chinese have developed it into an asset.

SOAP CARVING

AS PREPARATION FOR STONE CARVING

By the Author

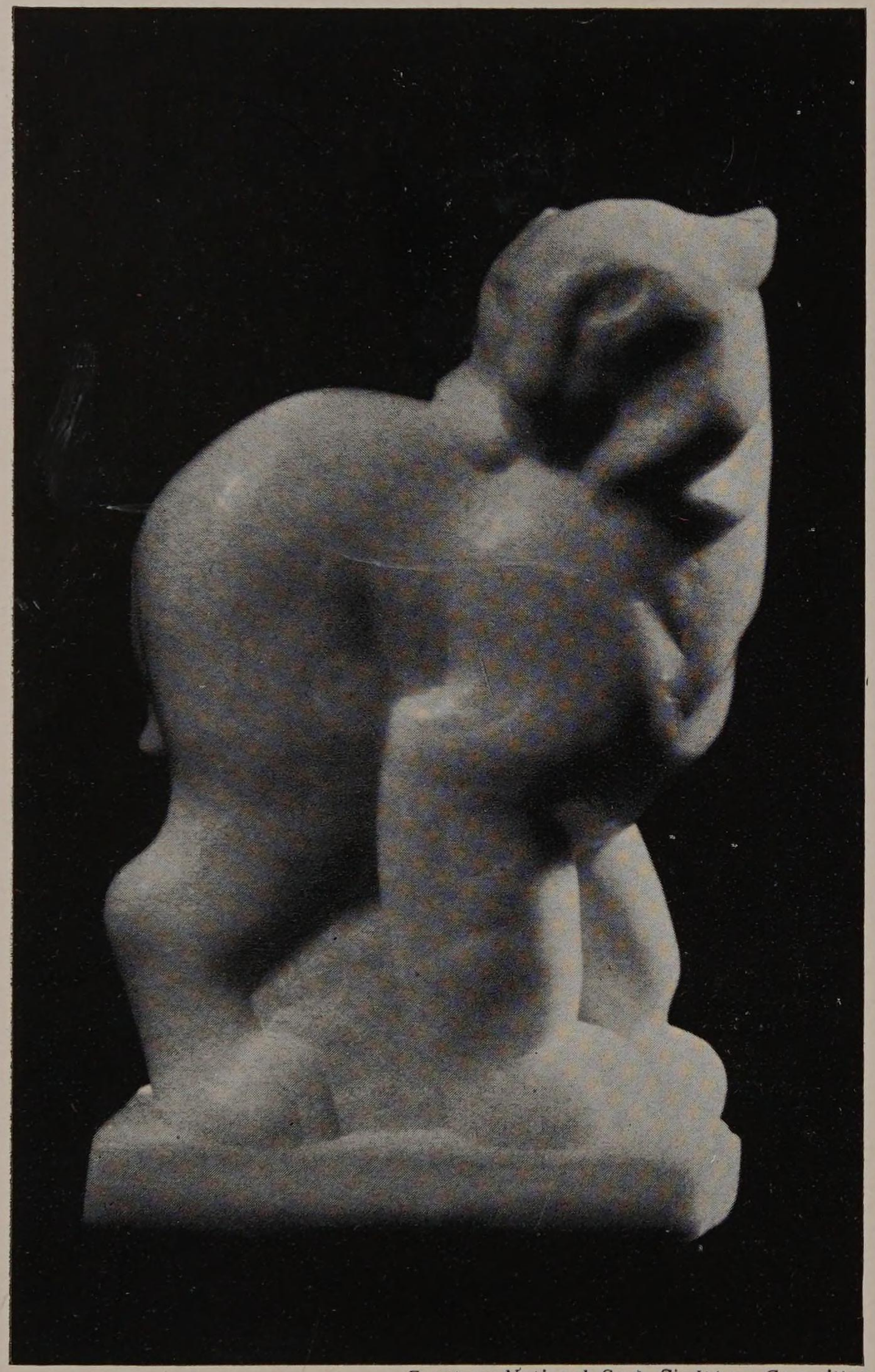
Before you begin the arduous task of carving anything directly in stone or marble, it will be excellent practice for you to procure a few cakes of some white soap, such as Ivory, laundry size, and accustom yourself to thinking your work inside a solid block.

Some of this training has already been acquired if you have put into practice the exercises suggested in Chapter III, but soap is a step further along the road. Clay, after all, *can* be replaced if a careless stroke of the tool cuts off too much, but soap can not and must be carved slowly and thoughtfully down to its ultimate form. It can, moreover, be carved anywhere, away from your own studio, as the only tools necessary are a penknife and a wire hairpin.

As in creating clay compositions within geometrical boundaries, your first concern must be to select some simple, blocky form which will fit well into the "brick" shape of the soap, thus entailing a minimum of cutting away. It was the shape of the soap which suggested to me the "Faun" in Plate 171. Heavily built animals, for instance, such as elephants, sea lions, or bears, lend themselves beautifully to one's first efforts at carving. And the human torso also fits well into such a block.

Once you have chosen your subject, lightly scratch the profile views on both sides of the cake of soap, seeing to it that they correspond fairly accurately. Then do the same on front and rear ends. With the penknife, boldly carve away the largest masses, keeping well *outside* the outline of the figure until the main form is blocked in. After that, a wire tool or hairpin may be used to modify some of the angular surfaces and enrich the modelling. Thin parts, like a very thin base, are apt to warp as the soap gets older, and the whole mass will shrink and harden a bit. This hardly matters, however, as you are doing this for practice, not for posterity.

When exhibitions of soap sculpture were first inaugurated about fifteen years ago, many entrants had the mistaken idea that the most delicate and elaborate carvings would command the most respect. They carved whole landscapes, with every leaf on every tree, or lively, fussily dressed ballerinas poised on one toe. Such fragile things were invariably broken before the exhibition started. Moreover, the judges were looking for truly sculptural carvings, and the award invariably went to works conceived along large and flowing lines—works that, had they been judged from photographs alone, would have looked like heroic-size marble carvings.



Courtesy National Soap Sculpture Committee

PLATE 170. Lynx, *Soap Carving*. Beonne Beronda



PLATE 171. Faun with Grapes, *Soap Carving*. Brenda Putnam

Soap carving may sound like a trivial pastime to those who have never attempted it, but it is actually nothing of the sort. It is hard work, mentally if not physically, and is the finest preparation in the world for the stone carving you will want to try when you have read the following chapter by Robert A. Baillie, one of the most artistic and skillful carvers in this country—an interpreter in marble of other sculptors' work, as Yehudi Menuhin is an interpreter of the works of the great composers.

CHAPTER XIII

STONE AND MARBLE CARVING

Robert A. Baillie

THE renewed interest in direct stone carving which we see all about us today is a most heartening manifestation. No amount of modelling in soft materials can ever give the student as deep an appreciation of rich and noble form, as will the experience of actually carving his work out of a solid block of resistant stone.

The mistake of many ambitious students, however—and here they are often injudiciously encouraged by the art critics—is to think that because they have labored with the sweat of their brows, it follows that they have produced a masterpiece. This is not necessarily so, nor is it likely ever to be so, if the tyro has chosen granite or some other very hard stone for his first experiments.

If, for instance, the student tries to carve a head out of a paving block, he will hardly be able to do more than scratch the surface, and the "primitive," flat-faced cube which he calls a head will still resemble a paving block more than anything else. In that sense, of course, it will have a satisfactorily stony and "sculptural" appearance, but credit for this result should be given to the stone—not to the sculptor. The work is "finished," yes—because the exhausted carver just couldn't go any further!

For your first attempt at stone carving, you should use a block of French Caen stone (pronounced "Cain" in this country). This is fairly soft and easy to cut, and of a pleasant warm buff color. Choose some very simple subject that makes a solid mass, such as a crouching bird or rabbit. Make a rough clay sketch of your model first, as a general guide to what you are going to carve. Set this up beside your block of stone which, unless it is quite heavy, should be fastened to your stand with plaster to hold it firm while cutting.

The next thing is to establish the very *center* of your clay model. Then find the corresponding center of your block of stone, and *think* the figure within that stone, drawing the outlines roughly on all five surfaces to be sure that the form lies well within the block you are to carve. Of course, soon after you begin cutting, the outlines will be obliterated, so you must constantly keep the central point in mind as you work.

TOOLS

You should have both a wooden mallet and iron hammers, not heavier than two pounds. Also a set of chisels, as shown in Plate 172. The three at the left are called



F.E.W.

PLATE 172. Stone-carving Tools

"points," and will be used first, to break into the material. With these and an iron hammer you will do the first roughing-out of your carving. The next four, toothed chisels, are used after the main mass has been blocked out, to get the stone down closer to the required form. The finer smooth chisels at the right will be used in finishing. The wooden mallet will be better than the hammers for the last stages, as it deals a lighter blow. Below the chisels lies a long drill, for boring tiny holes in the stone, as in taking "points." And at the bottom are rasps, both coarse and fine.

The beginner instinctively grips his chisel tightly in his left hand. He must learn not to do this, for the chisel should be held loosely, ready to spring away the moment it has done its job. Never *force* a pointed chisel too far. If you do, the tip will break off in the stone. Instead, attack the stone from some other angle.

Be careful, when roughing out, never to come nearer than within half an inch of the actual form, or a misguided blow may knock off an irreplaceable piece. You will find as you progress that stone, like wood, has a definite cleavage and works in one direction better than in another. You will also find that you soon come to prefer one tool to another. Every carver has his pet tools and I find that two people will work entirely differently with the same chisels. Many sculptors use rasps or "rifflers" to finish their work, but to my mind the best bits of carving were all finished with a fine chisel. Rasps, contrary to the prevailing notion, *harden* rather than soften the contours and should be used very sparingly.

As your carving progresses, the stone itself will suggest improvements over your first sketch. If you are sensitive to its messages, you will modify certain details as you work—leaving a bold plane where your sketch indicated a round or broken surface, and eliminating many unnecessary holes and details of fur or feathers. This is undoubtedly the way Michelangelo worked, as we see when we compare his rough wax sketches with the large marbles. And many times the very limits of his block forced him to revise an attitude, a turn of head or thrust of knee, accentuating the compactness and solidity of the larger work. Many stones have veins, much as wood has a grain, and sometimes by following what these veins suggest you will get a finer effect than you had ever thought of when you were making your clay model.

STONES AND MARBLES

After several practice works in Caen stone, you will want to try your hand at something harder and more durable. Indiana limestone would be good to use after

you have familiarized yourself with the rudiments of carving. This stone, unlike Caen stone, which cannot be placed out of doors, hardens as it "weathers" and will last indefinitely out of doors. The pyramids of Egypt were mostly constructed out of a limestone similar to our Indiana. This has a higher percentage of lime in it than the Egyptian stone, enabling it to withstand the bitter frosts of our winters.

As for marbles, we have not yet found anything in America to equal Carrara or Seravezza (the best of Italian marbles), or the Greek Parian marble. But these, though beautiful, will last only about twenty years outdoors in this country, or, if carefully protected throughout the winter, forty years at most. The climate here takes tremendous toll of all stones imported from abroad and the sculptor will do well to familiarize himself with all the fine American marbles that are available.

The Lincoln Memorial and the Folger Library in Washington (including the reliefs by John Gregory) are of white Georgia marble. But Georgia is rather coarse in texture, with large brittle flakes or "pyrites" which will not stand free-carved details. The statue of "Puck" at the Folger Library, with its free arms and hands, could not have been carved safely in Georgia. So for that, another, finer-grained marble from Alabama was used. This sometimes has dark lines running through it, but if you can escape those, you will find it a beautiful creamy marble, as handsome as the Italian and far more durable.

Vermont and Colorado Yule marbles are fine in texture, but do not endure nearly as well as Georgia or Alabama. Pink Tennessee lasts well out of doors and has a warm rosy tone—almost flesh color. The Maine Memorial, Columbus Circle, N. Y., and the D. A. R. Memorial in Washington were carved in pink Tennessee.

There are many other American stones and marbles, in various colors, and of course there is splendid granite from Maine. One of the hardest stones known is a black marble from Belgium; Sweden and Norway produce some very beautiful green marbles; France has other stones beside the Caen, one of which is a pearly gray, a very fine stone called "Pierre de Tonnerre," or Thunder Stone. England yields both stone and alabaster. Alabaster is softer than marble, and can be carved with wood-carving gouges. To purely decorative pieces, the translucent quality of alabaster lends a certain charm, but I do not recommend it for portraits, as this very quality blurs the forms, obliterates shadows and greatly detracts from any likeness you may have achieved in your clay model.



E.S

PLATE 173. Pointing Machine on Marble Bust
1—main shaft; 2—legs; 3—jointed arm; 4—point; 5—set-screw for point

THE POINTING MACHINE

To the layman, the process of accurately copying a piece of sculpture in marble is a complete mystery, especially as the work is frequently done by someone other than the artist creator. "How can you be *sure* it will come out exactly the same?" the layman asks.

The only way to understand thoroughly how a pointing (or measuring) machine works is to see it in operation. But when it is explained to the layman that this machine accurately measures every part of the plaster model at *hundreds* of different points, about a quarter of an inch apart, he will see that the carver cannot go very far wrong between these points.

It takes skill to measure accurately, and it takes interpretive art as well as skill to carve the stone or marble to a true likeness of the plaster model. A poor carver can make a botch of such a job, but a carver who is also an artist interprets the plaster model much as the musician interprets the printed score.

The pointing machine was perfected by the Italian sculptor, Canova. It has become a necessary part of the carver's equipment. Plate 173 shows such a machine set on the bust of Gabrilowitsch. Roughly speaking, it consists of two main rods, one upright and the other horizontal, somewhat like an inverted T. These rods are adjusted to the size of the piece to be carved and immovably joined together. Sliding up and down on the vertical rod is a jointed "arm," at the end of which is an adjustable needle which measures points first on the plaster, then on the marble. Every time such a measurement is taken on the plaster, the needle is "set," so that, though it may be withdrawn several inches, it cannot be pushed forward further than the given point. The machine is then lifted over onto the marble, and the needle pressed gently to the surface of the stone. It will not go the whole distance, of course, because the marble is larger than the plaster model. Withdrawing the needle again, the carver cuts away the marble at the point where the needle touched it, until he has made a hole deep enough for the needle to go in almost its adjusted length. In Plate 175 the needle is set to measure a point on the cheek.

The machine stands on three main "legs," which rest on small rivets driven into the plaster. (In this case, there is one rivet on the top of the head and two on the chest.) Corresponding rivets are imbedded in the marble. The carver finds first of all the most projecting part of the plaster model. (In this case, the end of the nose.) Once this

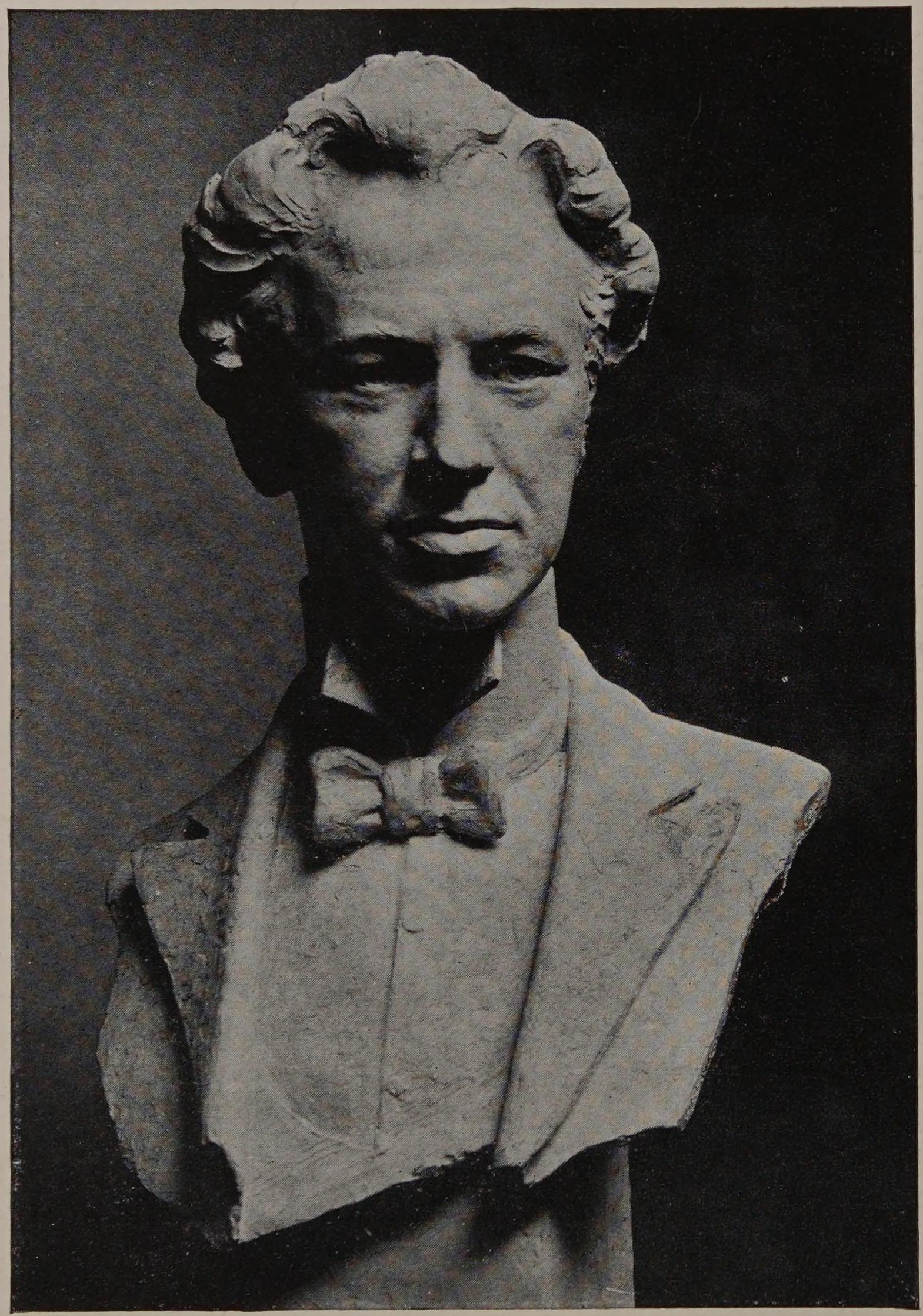
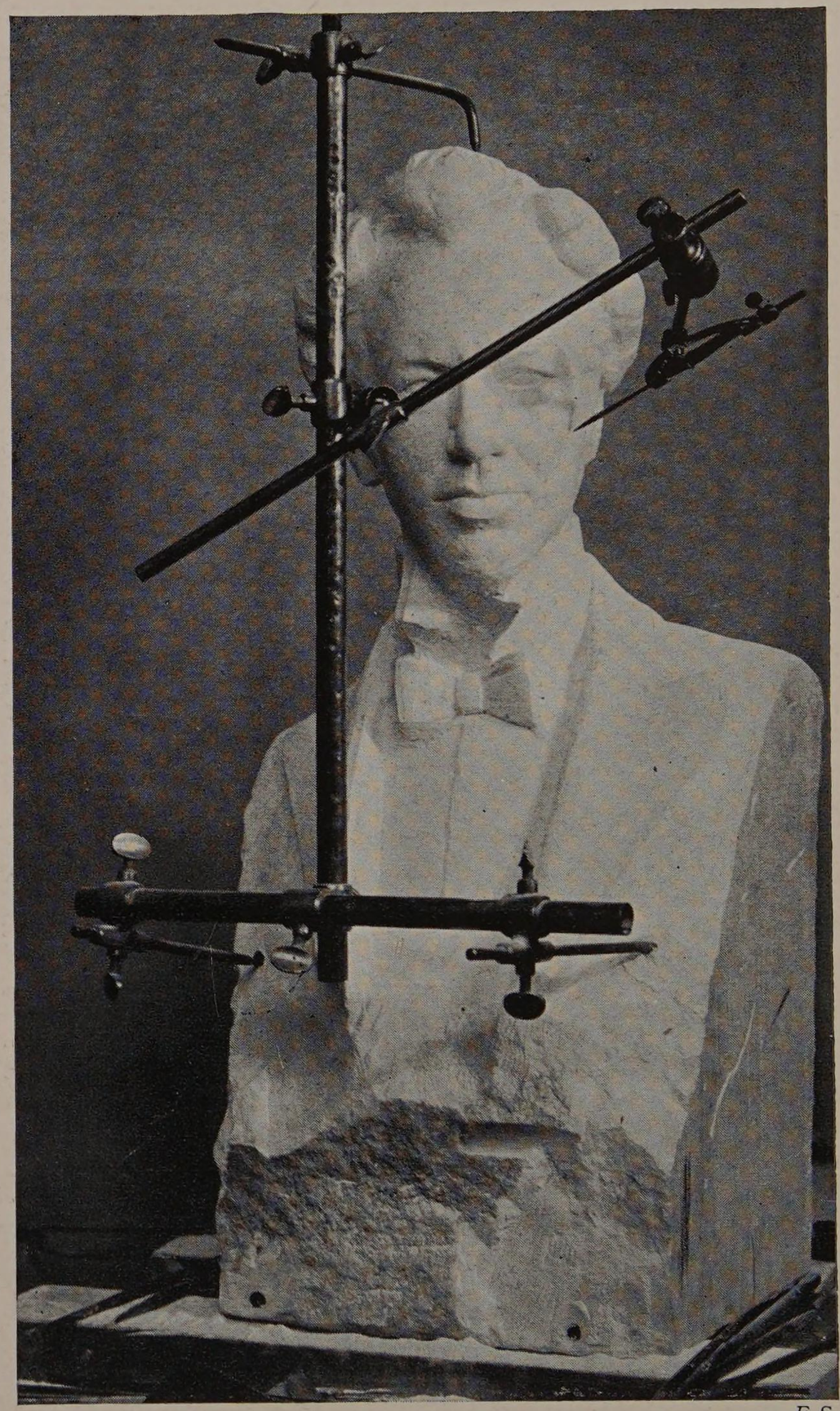


PLATE 174. Ossip Gabrilowitsch, *Plaster*, by Brenda Putnam



E.S.

PLATE 175. Measuring a Point on the Cheek



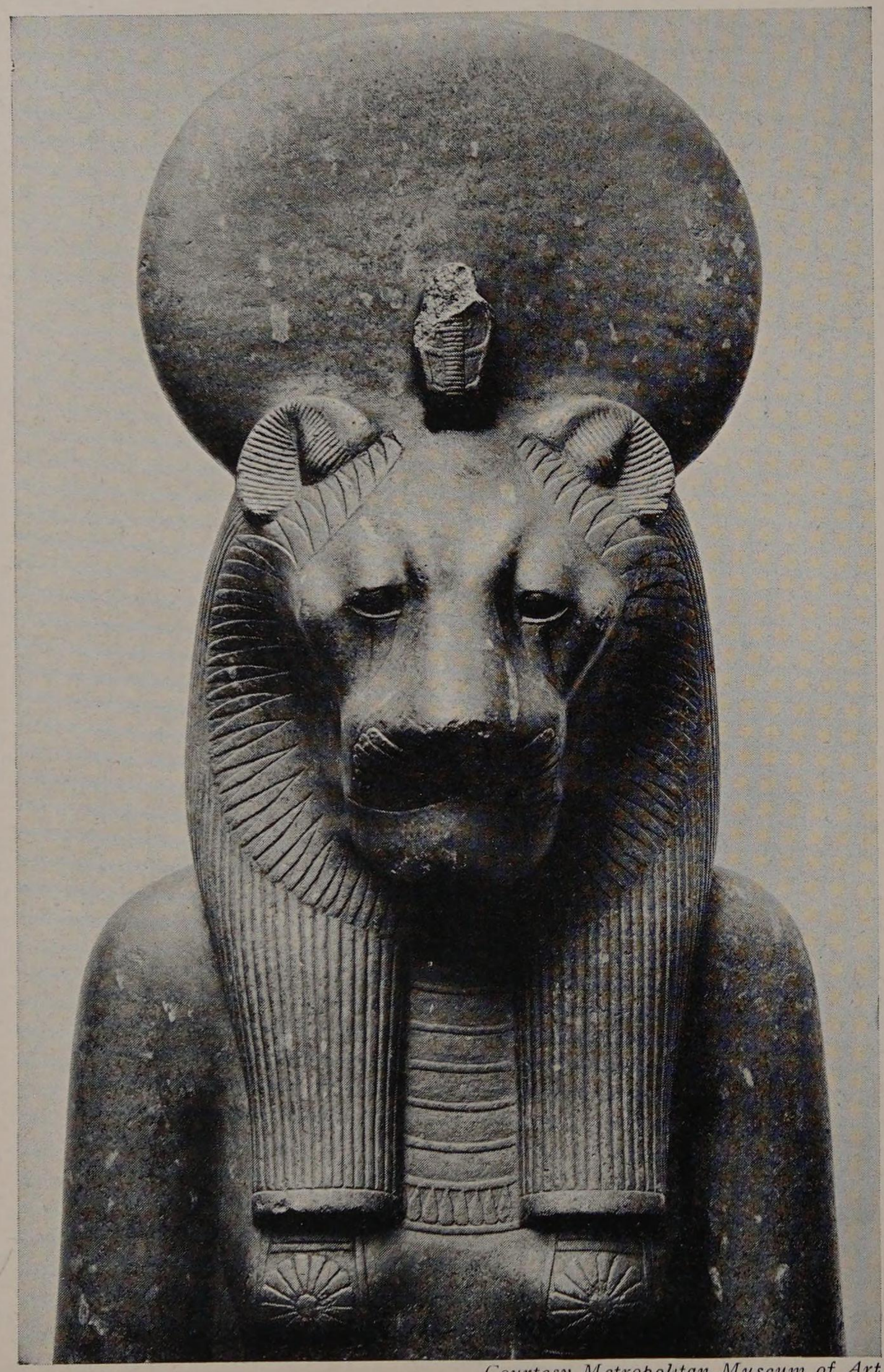
E.S.

PLATE 176. Mr. Baillie at Work on the Portrait Bust

outermost point is established by a small excavation in the front of the marble block, the rest of the surface is roughly chipped away to make sure that there are no flaws in the stone. Then another high point, such as the brow, is found, and so on until the major forms of the head are roughed out. Each time a point is taken, it is marked by a penciled dot on the plaster and by a tiny drill hole in the marble, so that before long both model and marble are pockmarked all over.

The carver never takes a point in a hollow, but always measures the projecting parts. Thus he is sure never to cut away too much. For marking points below the surface of the marble, the carver uses a long drill, boring a hole to the required depth. None of his points are measured entirely down to the level of the plaster model—he always leaves a fraction of an inch between the tip of the needle and the plaster surface, so that until the final stage, the marble is ever so slightly larger than the plaster. When this stage is reached, all the points, or tiny holes, will be chiseled or rasped off the surface.

After the student has had some experience in freehand carving, he should learn



Courtesy Metropolitan Museum of Art

PLATE 177. The Goddess Sekhmet, *Diorite*, from Karnak

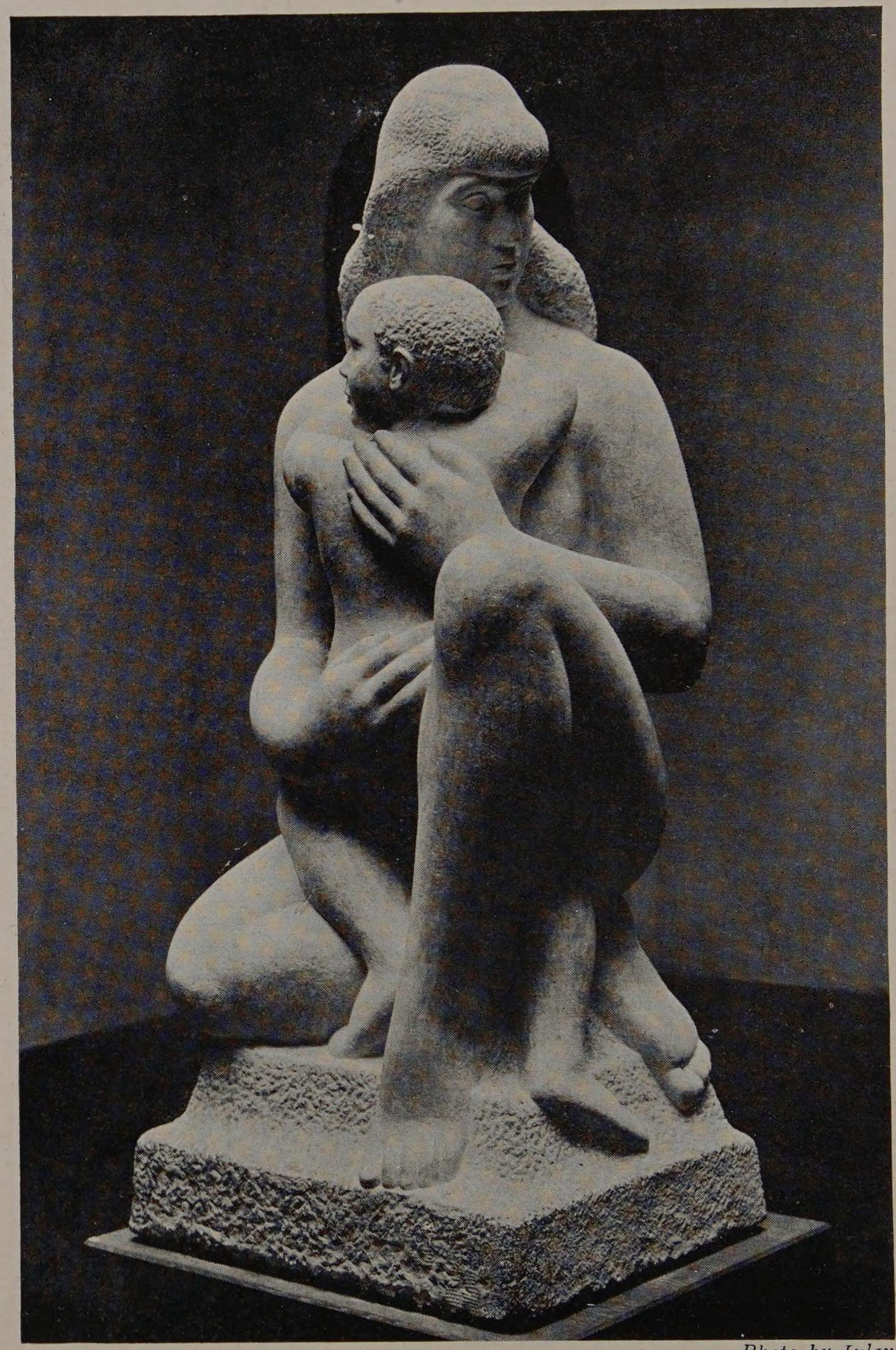


Photo by Juley

PLATE 178. Mother and Child, *Stone*. William Zorach



Courtesy Metropolitan Museum of Art

PLATE 179. "The Bather," *Marble.* Auguste Rodin

to use the pointing machine and make an accurate, measured copy of one of his own figures or heads. A few months of such work in a carver's studio will give him an understanding of, and respect for, the carver's art, which really cannot be learned except through practical experience. Many technical hints, such as how to make and how to sharpen tools, how to stain or oil marble, how to raise and move about huge



Photo by Acme

PLATE 180. James Earle Fraser's "Benjamin Franklin." The Various Sections Being Assembled and Put Together

blocks of stone with a minimum of effort and danger, etc., will be picked up through contact with the carvers in such a studio. Most of our best sculptors had, in their youth, several years of such training and, working under the guidance of skilled craftsmen, they learned many things which were later of value in their own creative work.

Heroic-size figures are frequently carved in sections, for convenience in handling. Later, the sections are carefully fitted together, interlocking by means of "Roman" joints. For instance, in Plate 180, one sees projections on the sole of the shoe which will fit into corresponding holes in the "floor" of the statue.

Since the days of the mighty Michelangelo, the art of carving has lost much of the respect to which it is entitled. After the pointing machine was perfected, sculptors too readily turned their work over to a carver as they would to a plaster caster, and gave him but little credit for the ultimate result. For a long time now, carvers have been classed as artisans, rather than as the artists they really are. It is to be hoped that the revival of interest in direct carving will do much to make people appreciate the art and skill which the carver must have at his command.

We consider many musicians great artists, although they have never *composed* a single tune. A fine pianist or singer can make a mediocre composition sound beautiful, and a fine carver, if permitted to interpret a plaster model in the proper stone, can likewise make an artistic creation from a mediocre model.

Of course, the men who do purely mechanical ornamental carving on buildings, using pneumatic tools to save time and labor, and mechanically copying the model given them, can hardly be called more than skilled workmen. But the true artist carver may be a professional man of real distinction and, to those students whose interpretive gift is greater than their creative ability, I suggest carving as a dignified and ever-interesting profession.

It would be a splendid thing if a guild of carvers were formed in this country—carvers who by their skill have risen to an artistic plane higher than the general run of unionized stonecutters. Such a guild would function both with the architects and with the sculptors, and help immeasurably to lift the standards of sculpture.

When we consider that stone carvings are the only lasting records we have of many vanished races and civilizations, we realize that the carving done today may, 2000 years hence, be all that will remain of our own civilization.

CHAPTER XIV

WOOD CARVING

Gleb Derujinsky, A.N.A.

THE three primary rules for carving in wood are these: Know your wood; know your tools; keep them sharp.

Wood is a most beautiful medium for the sculptor, and he who has carved much grows to love his wood. Every kind, every piece, has its own individuality, which challenges the sculptor to bring out its hidden beauty.

Like any other branch of sculpture, wood carving demands years of training—years of labor and of experiment—before the sculptor may hope to achieve his goal. A few months spent in a carving shop will teach him more than he can ever learn by himself about the various woods and how they must be handled; he will learn many tricks of the trade from the older craftsmen, which will be of inestimable value when later he works alone in his own studio.

Soft woods, such as yellow pine, are not so good for the beginner to start with as some that are firmer and have a close, even grain, such as lime, birch, plane, basswood, Cuban mahogany, teak or walnut. Still harder, but beautiful to carve, are English oak, French walnut, cherry; and pear or boxwood for very small work. Among the hardest of all are snakewood, ebony, lignum vitae, and coca-bola. The last two are extremely heavy, and so hard that they chip almost like granite.

The student, looking for small bits with which to experiment, can usually pick them up at any wood turner's shop. Lime or plane are good woods for the beginner. If whole tree trunks are needed for larger work, they may be found in the yards of lumber merchants. All wood must be thoroughly seasoned if it is to cut properly and not "check" (or split) as it dries out. Even though great care is taken,



F.E.W.

PLATE 181. Wood-carving Tools

however, most woods will check somewhat during the winter in our steam-heated houses. Some methods of overcoming this difficulty are described later.

TOOLS

The student will need about a dozen chisels, or gouges, and a wooden mallet, as shown in Plate 182. For a simple relief, five or six will do. The best wood-carving tools come from England. Herring, J. B. Addis, and C. Maier tools are all very good. The curved gouges are mostly used for carving the forms, while the V-shaped ones are used to incise outlines, drapery, etc. Every carver needs a sturdy workbench, of which the top should be at least two inches thick, and project beyond the frame at least two inches, to provide purchase for the clamps which must be used to hold the wood immovable.

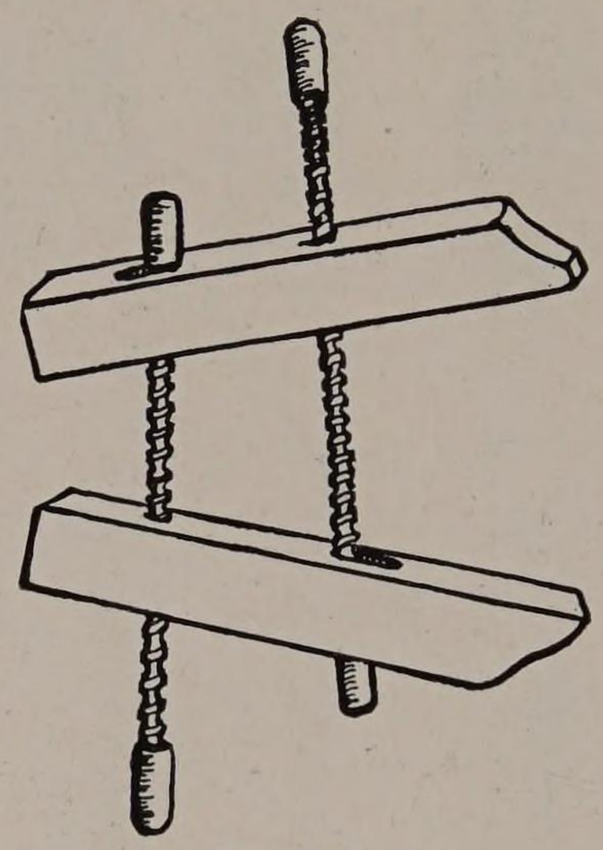


DIAGRAM 93

The best clamps are wooden ones, as in Diagram 93. These are flexible enough to fit almost any shape and will not mar your carving as metal ones would. The workbench should be equipped with a large wooden vise, and it will be useful to have a small grindstone, or emery wheel, attached to one corner of the bench, as much time must be spent in keeping your tools sharp.

Professional carvers tell me that in estimating a job they have to allot about one-third of the time to sharpening their tools. This will show you how important it is to keep them well-ground and honed. When you buy them they will be ground, but not yet ready for use. They must be further sharpened on a fine oilstone and then honed on a piece of leather. It is well to reserve one side of the oilstone for flat chisels,

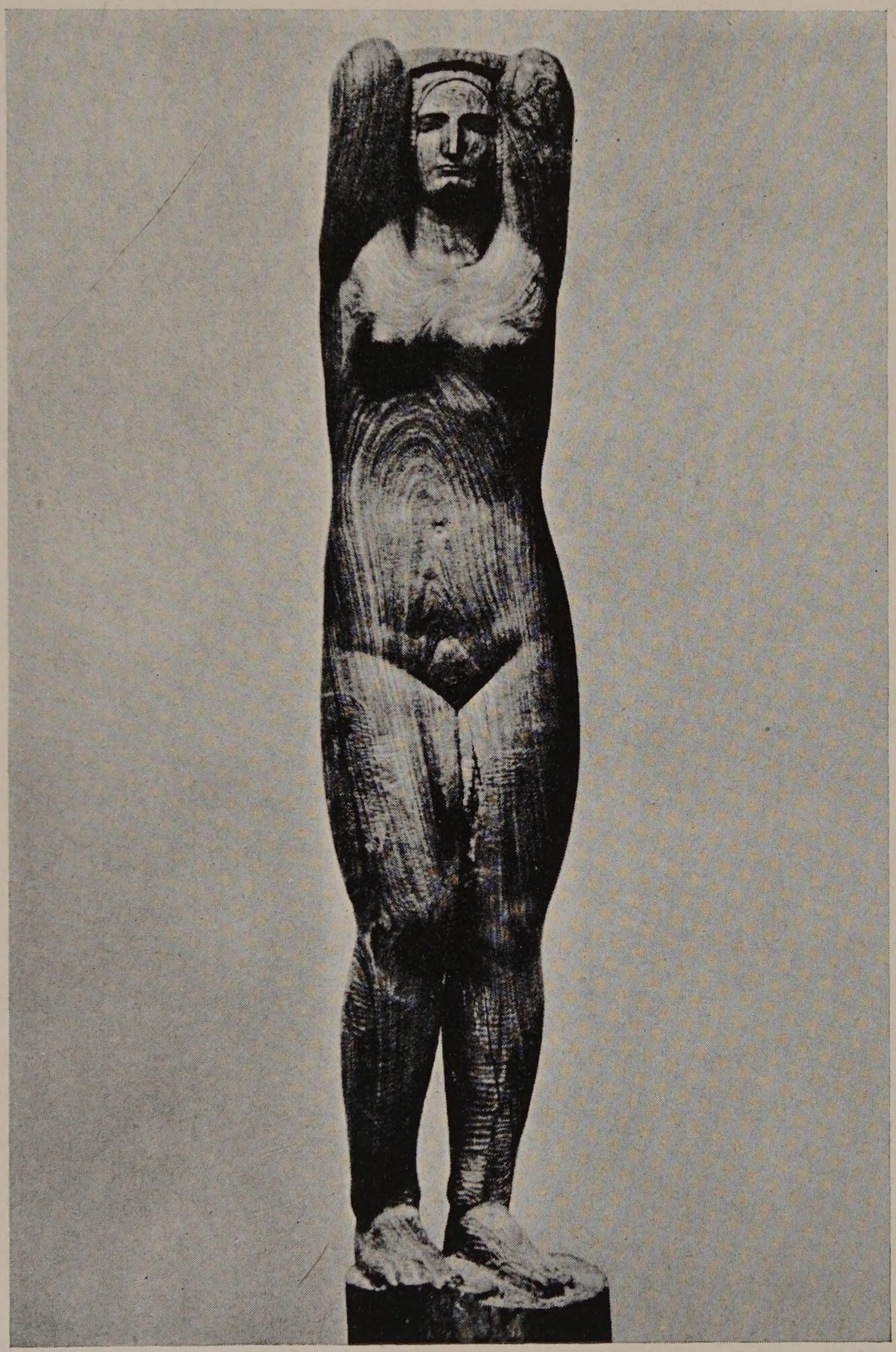


PLATE 182. "Caryatid," *Wood*. Ivan Meštrović

using the other side for curved blades, which will wear a groove in the stone and ruin it for flat edges. Always use a few drops of kerosene on the stone before you start sharpening and be sure the surface is wiped clean. In sharpening flat-edged tools, hold them at an angle of about 15°, with the fingers of the left hand pressing on the blade close to the stone. Rub from one end of the stone to the other with a

steady stroke, until one side is rubbed bright at the cutting edge. Then turn and sharpen the other side. This sharpening will leave minute "burrs" on the edge, which must be removed by honing or, more quickly, by jabbing the tool into a piece of soft pine.

A convenient hone is made by an eight-inch section of leather belting, set into the surface of a wooden block. Emery powder and grease should be smeared on the leather before using.

In sharpening a curved tool, rub it on the oilstone with a rolling motion, in order to bring all parts of the curve in contact with the stone. To sharpen the inner surface you must use a small, wedge-shaped "slip" of stone. Hold the tool in the left hand, with the shaft resting on the bench. With the right hand, work the rounded edge of the slip stone in a series of short downward strokes, beginning at one edge of the curved blade and ending at the other. The thin, sharp edge of the slip will sharpen the insides of the V-shaped tools. When the edge of a tool has been broken, it must first be ground even on the grindstone, but care must be taken not to grind the "temper" out of it. When tools are only slightly dull, the leather hone may be all that is required. For rather soft wood, sharper tools are required than for hard wood, as dull tools bruise the surface. But with very hard wood, too sharp a tool is likely to nick badly.

CARVING

To accustom yourself to using and sharpening the tools, you may wish first to try a simple bas-relief. Draw a fruit, leaf, or flower form on a small board and clamp it firmly to the bench. Ornamental carvers often begin such work by selecting a chisel that exactly fits a particular curve of the outline. Holding the chisel on the outline, and pointing it straight down into the wood, they give it a sharp rap with the mallet. For another curve, smaller or larger than the first, they use a smaller or wider chisel, until the whole outline has been sharply cut into, to a depth of about ¼ inch. Then, working as much as possible *across* the grain of the wood, sometimes *with* it, but *never against* it, they "rout" out the background with a succession of sweeping strokes. Other carvers prefer to outline their forms with the small V-shaped tool. If this is used, be sure to keep just outside the outline as you carve.

The mallet is always used for preliminary roughing-out. After that, the chisel may be driven with the palm of the right hand, resting the heel of the left hand on the carving to steady the tool. Experience will soon teach you how the grain of the



Juley

PLATE 183. "Annunciation," *Wood*. Gleb Derujinsky



Juley

PLATE 184. "The Angel Gabriel," *Wood*. Gleb Derujinsky

wood runs. If, for instance, you find that every time you try to carve from left to right, your tool drives in too deeply and digs up splinters of wood, you know that you are working against the grain and must carve either across, or from right to left.

If you now wish to begin on a figure in the round, select some simple, blocky form that has little undercutting, and no projecting arms and legs. For this, a modelling stand with revolving top may prove more handy than your workbench, if it is not too high. As clamps on your work would interfere with carving, fasten it to your stand as follows: Turn your block of wood bottom side up and lay a board over the bottom. Insert three screws through the board and into the base of the block. Replace on the stand and clamp the free ends of the board to the top of the stand. To prevent the revolving top from turning while you are carving, screw a large hook and eye respectively to the stand and to the top, and hook it as you would a door.

The sculptor usually prefers to carve the heart or core of a tree trunk, while the professional carver may prefer the outer slabs. Remember that in a trunk, the grain runs up and down. Most of your carving should be done across the grain, round and round the forms.

Draw the general outline of your figure in charcoal on the wood. If there are any places where the figure is set deeply inside the surface of the block, it may be a good idea, provided the wood is not very hard, to *saw* straight in towards the outline at that point, then chip away the wood towards the cut.

If your figure is standing with one knee partly bent, always carve *up* from knee to thigh and *down* from knee to shin. In the back, reverse the process, carving down from thigh to knee and up from calf to knee, so that you are never carving against the perpendicular grain of the wood.

As you carve, always keep one edge of your tool visible, so that you can see where it is going. If you should drive a chisel in too far, and cannot get it out again, do not struggle with it, or the blade will snap. Leaving it there, take another chisel and chip around it from a different direction, and the blade will soon come free. Be careful, too, never to hold your carving with your left hand where an unexpected slip of the tool may jab right into it. Such painful accidents are all too frequent among beginners.

The skilled carver always prefers to leave toolmarks on the surface of his work and never uses rasps or sandpaper unless absolutely necessary for some particular purpose. Sandpaper, indeed, except when a work is entirely finished, is dangerous to use, as the fine grains of sand stick in the wood and may ruin your best tools if you



Courtesy Bucholtz Gallery

PLATE 185. "Man Drawing a Sword," *Wood*. Ernst Barlach

use them again on that surface. A bit of sharkskin is far better than sandpaper, as it grinds down the surface the same way, but never wears off.

If your figure has a thin, "free" bit, such as a hand, you must calculate and so place it that the direction of the fingers runs *with* the grain. If the fingers run across the grain, they will most certainly break off. In wooden crucifixes you will note that



PLATE 186. "New-born Calf," *Wood*. Heinz Warneke *F.E.W.*

the outstretched arms are always carved separately, and glued or pinned on. Not because the carver could not find a block large enough to include the whole figure, but because in any single block, the grain would run across the arms, not along them, and they could not be carved without breaking.

The old German carvers used a special glue, made out of cheese, to stick wood together. If you have to glue sections together, be sure that both the wood and the glue are thoroughly heated before gluing, or they will not stick properly. If only a few minor checks develop as your work progresses, do not worry about them, as they may close up again later. I always wait until about January or February before doing anything about the cracks, for that is the time of their maximum expansion. If the checks interfere with your work, they can be temporarily sealed with beeswax, which is soft enough to squeeze out if the wood decides to close up again after the steam heat has been turned off. If a wide check refuses to close, it can be patched

with a sliver of the same wood. Plastic wood, a composition which may be bought at any paint shop, can also be used as a filling, but is difficult to match in color.

The best time to start a carving is in the spring, so that the wood will have time to weather before the heat goes on in winter. In a bulky carving it is well, also, to drill a 1-inch hole from the bottom well up into the upper part of the figure. This will allow air to reach the inside of the wood and make it dry out more evenly.

Linseed oil and floor wax may be used to polish a carving. They tend to darken the color, but bring out the beautiful grain in the wood. A steel brush is good for burnishing the surface, after it has been thoroughly waxed.

It is possible, as in marble carving, to have your wood pointed up from a plaster model by a professional carver. If you have carefully designed that model for wood, with clear-cut planes and decisive folds of drapery, such as the fine old carvers always made, there is no reason why, if your time is very limited, you should do more than finish carving the surface of your work. But a carving done entirely by mechanical means will be but a soulless thing and cannot be compared with one that was lovingly carved from start to finish by the creator himself.

Do not forget that wood carving is one of the oldest arts—probably as old as ceramics. Primitive peoples carved their gods out of wood long before they carved them in stone. One understands why, when one realizes that wood was everywhere at hand and that a fairly high stage of development had to be reached before man could manufacture tools strong enough to carve stone. Moreover, the lasting quality of wood as a permanent medium is proved by the remarkably preserved wooden statues of the Egyptians, which date back some 6000 years, and also by the grotesque totem poles of our Alaskan Indians, which for centuries have withstood bitter northern winters.

Wood does sometimes get worm-eaten and somewhat worn with great age, but bronze and marble can also perish, decayed from exposure to rain and salty or chemically impure air. In our museums there are perfectly preserved examples of wood carving by such great Renaissance artists as Verrocchio and Donatello. Most of these were painted after carving, as were the Egyptian wood carvings.

Yet in spite of all this evidence, some patrons of art hesitate to buy wood carvings or to order portraits in wood because they fear it is perishable. They also have a mistaken idea that wood should cost much less than bronze. Yet bronze is only a mechanical reproduction of an artist's work and is merely a more durable and

pleasing material than the original plaster—whereas a wood carving made by the sculptor himself carries the direct touch of the artist. It is a unique work of art that comes straight from the artist's hands, with no intermediate mechanical process. It should be valued as would a unique terra cotta, or a piece of direct marble carving.

So, if you discover that you love wood better than any other medium, do not be deterred by fear of its impermanence. You may be reasonably sure that your creations will live for many generations and, if they are really fine, will be increasingly valued, as time goes on, both for their beauty and for their unique quality.



E.S. *Courtesy The Brummer Galleries*

PLATE 187. "The Composer," *Wood*. Ossip Zadkine

CHAPTER XV

BRONZE CASTING

Anton Basky

BRONZE is an alloy of copper, tin and spelter (zinc).

Reputable foundries use only such a combination of these as is prescribed by a United States government formula. Cheap foundries, turning out low-priced commercial work, frequently use scrap materials, with less skilled workmanship, and should not be employed to cast works of art.

Only very small objects, such as paperweights, are ever cast in *solid* bronze. Bronze casts are hollow and hardly ever more than a quarter of an inch thick, as otherwise they would be not only appallingly heavy, but unduly expensive.

You will probably never attempt to cast a figure in bronze, yourself, but you should know something about the process of bronze casting, if only to appreciate what is done while your work is at the foundry. Most students, and many professional sculptors, know nothing whatever about this intricate process. All they know is that it takes an unconscionably long time and costs an unconscionable amount of money. If you take even an uncomplicated small figure, say 20 inches high, to a foundry, you may expect to wait from two to four weeks before you get the bronze, and with the bronze will come a bill for anywhere from $50 to $150 for the casting. Why is this?

Bronze casting is so complicated that it is almost impossible to explain in words. If you ever have a chance to visit a foundry and see some of the work going on, do not miss it, for such a visit will teach you much. Meanwhile, as clearly as I can

I will try to describe here every step of the processes which your plaster model must pass through at the foundry. There are two much-used methods for bronze casting, the *sand* method, and the *lost-wax* method. The former is described here, as it is perhaps the most used and the most generally satisfactory.

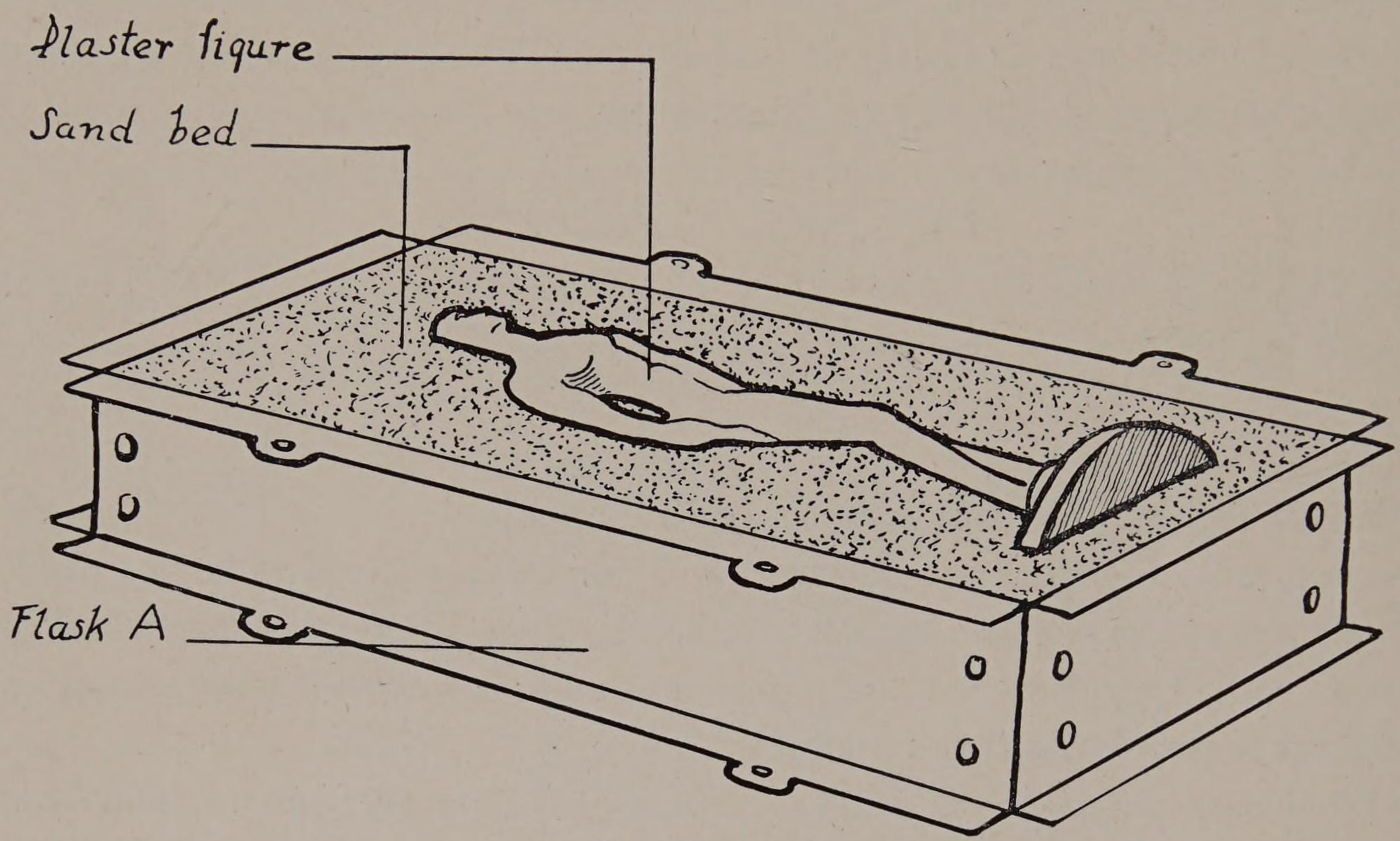


Diagram 94

After your plaster model is shellacked, to prevent its absorbing moisture from the damp sand in which it is to lie for a week or two, it is taken to its "bed." The "bedstead" is a foursided iron fence, or frame, at least 8 inches longer and wider than your plaster figure. This frame is called a *flask.* The founder prepares three of these flasks, of exactly the same size. The first frame, flask A, is placed on a table and completely filled with especially prepared and finely sifted French sand. This is almost as soft to the touch as powdered plaster, but of a reddish-brown hue. The plaster cast, lying on its back, is imbedded in this sandy "mattress" and pressed down until the rear half of it is completely submerged (Diagram 94). The bed is then tamped down smooth and level, and dusted with a fine powder made of talc, silica, or ground bone. This "parting," as it is called, is pounced on from a small cloth bag. More sand must be put on top of this, but because of the parting, will not stick to it. Now, because your figure was modelled in the round it will have *undercuts,* so the

founder must make the mold of this front half of the figure not in one mass, but in dozens of small sections—often from 25 to 75 of them on one side alone, if there is much undercutting. The sand is so *coherent* that the separate sections can be lifted up and moved about if necessary.

THE PIECE MOLD

Skill and experience show the founder just where to separate the sections. With a few pinches of sand he forms the first one, down where plaster and bed meet, along the main seam of the figure, ramming the damp sand firmly against the plaster. Then, using great care that his knife does not penetrate too far and cut into the plaster, he pares off the top and sides of this small piece to a clean-cut shape. Dusting it with parting, he then begins forming the second piece next to the first one. Thus, piece by piece, he builds up a mold about 2 inches, or more, thick over the front half of the plaster cast. This mold must have a strong outer shell to hold it immovable, so flask B is now superimposed on flask A, and pinned and "keyed" onto it. Two more inches of sand are now piled on top of the piece mold and packed down. This layer is further strengthened by several iron rods, bent to conform to the bulging surface of the sand, and laid crisscross at intervals and fastened to the sides of the flask with wire. Paste is also used to make rods and sand stick together in an immovable mass. Now still more sand is rammed in, up to and overflowing the rim of flask B. A wide, heavy board is pressed down on this pile, and shoved back and forth until it lies perfectly tight on the sand.

Large wooden clamps now fasten flasks A and B still more firmly together and the whole thing is *turned upside down.* Flask A with the original "bed" is now uppermost. The bed is dug away from the plaster cast, leaving its *rear* half exposed and its other half imbedded in the piece mold. Again the founder begins his patient and exact piece molding, dusting between each little section, until the whole back of the cast is covered. Again he makes an outer shell of tightly packed sand, reinforced with irons and wires. Diagram 95 shows what a cross section would look like at this stage, if we sawed straight through flask, sand and plaster model.

Now the piece mold of the whole figure is finished. The next step is to get the plaster *out.* The large clamps are removed and flask A is lifted off. With it comes the outer sand shell, exposing the piece mold. The flask is turned over and laid on its back, so that the concave shell may serve as a receptacle for the various sections of the piece mold, which are now gently lifted one by one, with a sort of two-pronged

fork, *off* the plaster and nested into their proper places in the outer shell. Here, then, lies a complete "negative" of one half of the figure. It is set carefully to one side and the founder now takes his *third* flask (flask C) and sets it on top of flask B, which still contains the plaster model. More sand is packed in to the very top of flask C; the two are clamped together and once more turned upside down. Flask B, now the uppermost, is removed, taking the outer shell with it, and the process of removing

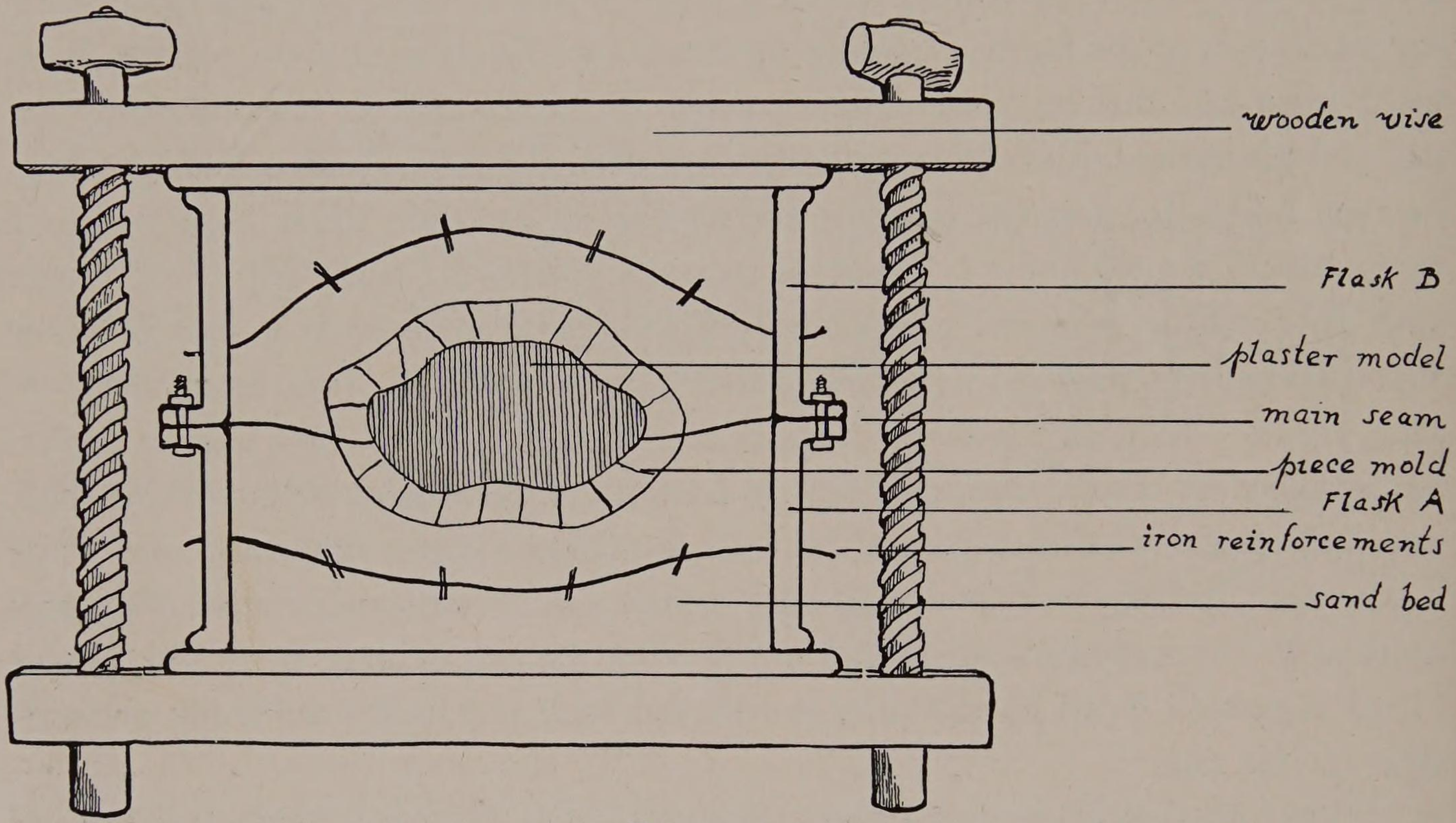


Diagram 95

the sections of this half of the piece mold is repeated. As soon as this is done, the plaster cast may be lifted from the sand and set aside, as it will not again be needed until after the bronze cast is made. A last precaution is taken to make sure that none of the small sections of the piece mold slip from their place: very long, very thin nails are driven through the sections into the outer shells.

MAKING THE CORE

The front half of the piece mold is usually deeper than the rear half, so the founder prepares this for the *core* which he must now make, by dusting it liberally with "parting." Then, with his fingers, he very carefully presses a thin layer of sand

into the mold. He is about to make a sand "cast," or rather "press," of your figure. This must have an armature inside it, built around a rigid central axis. The founder takes two heavy, straight iron rods, one of them long enough to project at either end several inches beyond the piece mold, at head and foot, and the other long enough to project likewise when fastened across the center of the mold, at right angles to the first. This second rod will prevent a possible slipping or turning of the core on its iron axis. An "armature" of twisted and curved wire is then built upon these rods. Great care must be taken not to scratch the delicate surface of the mold, and to so bend the wires that nowhere do they come too close to the surface. Next, several strips of waxed tape are laid along the armature, projecting at both ends beside the main rod. Their use will be described later.

Now the founder gently presses and squeezes more and more sand into the mold, between and around the wires of the armature. This time he does not stop building up when he reaches the level of the bed, but goes on heaping up the sand figure, modelling it into the general shape of the plaster cast. When he thinks he has it nearly right, he places the other half of the mold face down on his work, then lifts it off again. The impress is not quite perfect; parts must be pared down or added to. The mold is again lowered and again lifted off. This process is repeated until the founder has a perfect sand replica of the plaster figure. Now, with a specially curved spatula, he begins paring off a quarter of an inch from the entire surface of this press, or *core;* first on the exposed side, then, by the topsy-turvy procedure, from the other, until the whole core is diminished by at least a quarter of an inch. After this shaving process, another test must be made to insure that the core does not lie too near to the mold at any one point. If it does, the bronze will be too thin at that point.

FLYING THE CORE

With tiny pinches of sand, called "flies," the founder dots the core all over, the flies lying about an inch apart. Again the molds are closed over the core; if a single fly is mashed by the process, the core must be further pared down at that spot.

THE DRYING OVEN

Now the flies are brushed off the core. Carefully lifted by the two projecting ends of its central iron rod, and balanced by the cross bar, it is painted with graphite

or red talc and laid tenderly on a soft bed of sand covered with tissue paper. This bed lies on a sheet of steel. Lifting this, the founder places the core in a drying oven, where it will remain over night. The heat of the oven bakes the sand almost as hard as terra cotta. It also melts the wax tapes which run through the core. As these melt away, they leave ducts or channels through which gas will escape when the bronze is poured in. Were these not present, the gases would accumulate in the mold and the bronze could not flow in properly.

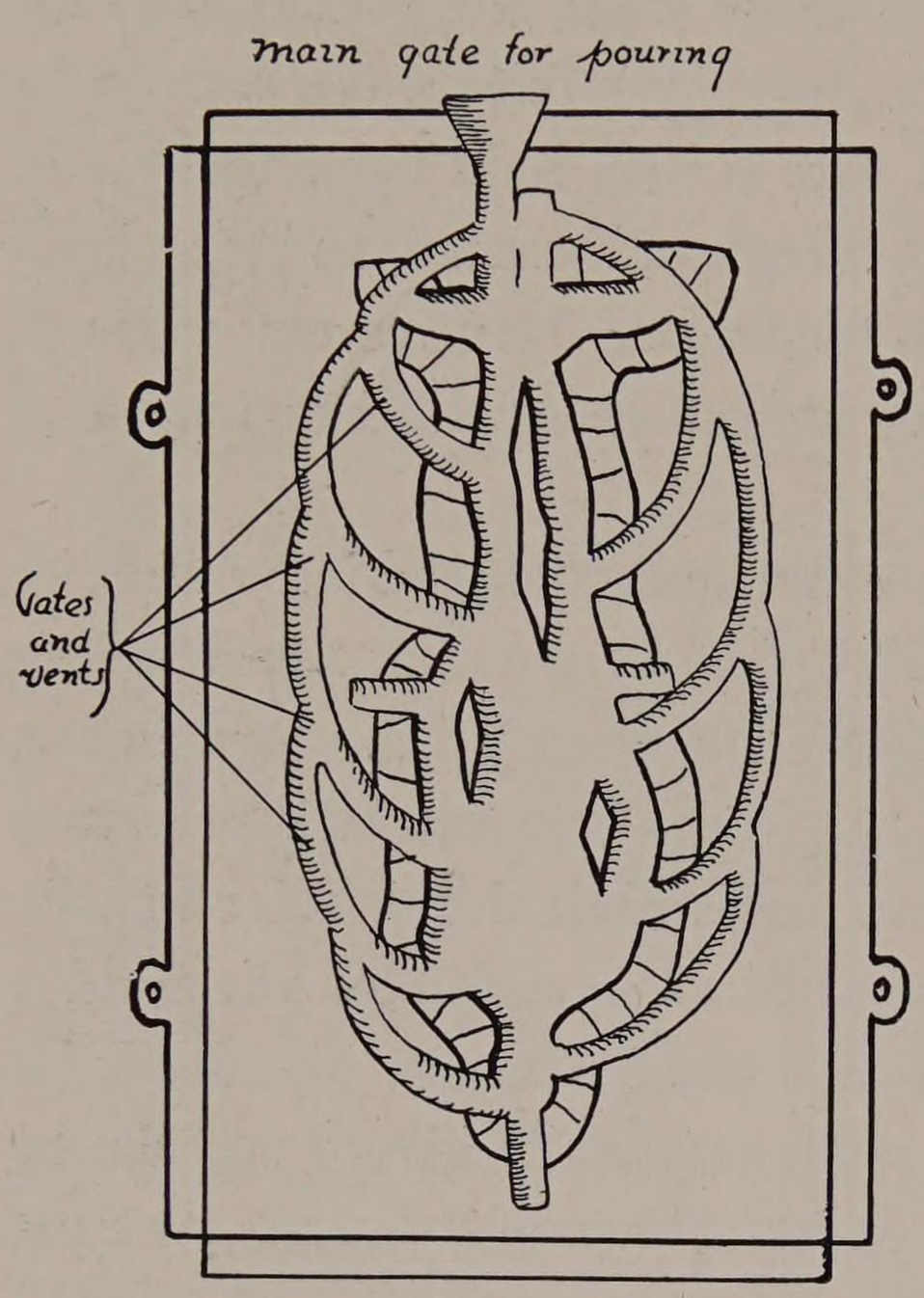


DIAGRAM 96

GATES AND VENTS

Returning to the piece molds, the founder now excavates a number of grooves along the upper surface of both "bed" and rim of each piece mold. These all proceed from a fairly wide groove cut just above the head or below the base of the figure, through which groove the molten bronze will be poured. The direction and disposition of these canals call for much skill, as they must not only conduct the bronze *instantly* to every part of the figure at once, but must allow the air to escape as well. The passages for bronze are called "gates," and those for air are called "vents" (Diagram 96).

Now the molds are ready for the overnight drying and baking process. It has taken anywhere from a week to a fortnight to make them. It will take less than ten minutes to pour the bronze and actually produce the cast!

MELTING AND POURING THE BRONZE

While core and molds are drying, a good coke fire is started in the bronze furnace, which lies below the level of the foundry floor. Great crucibles, or earthenware pots, are embedded in the hot coals. First the copper is melted down, bit by bit. The tin and spelter are added only just before pouring, as they are volatile and tend to boil away if added sooner.

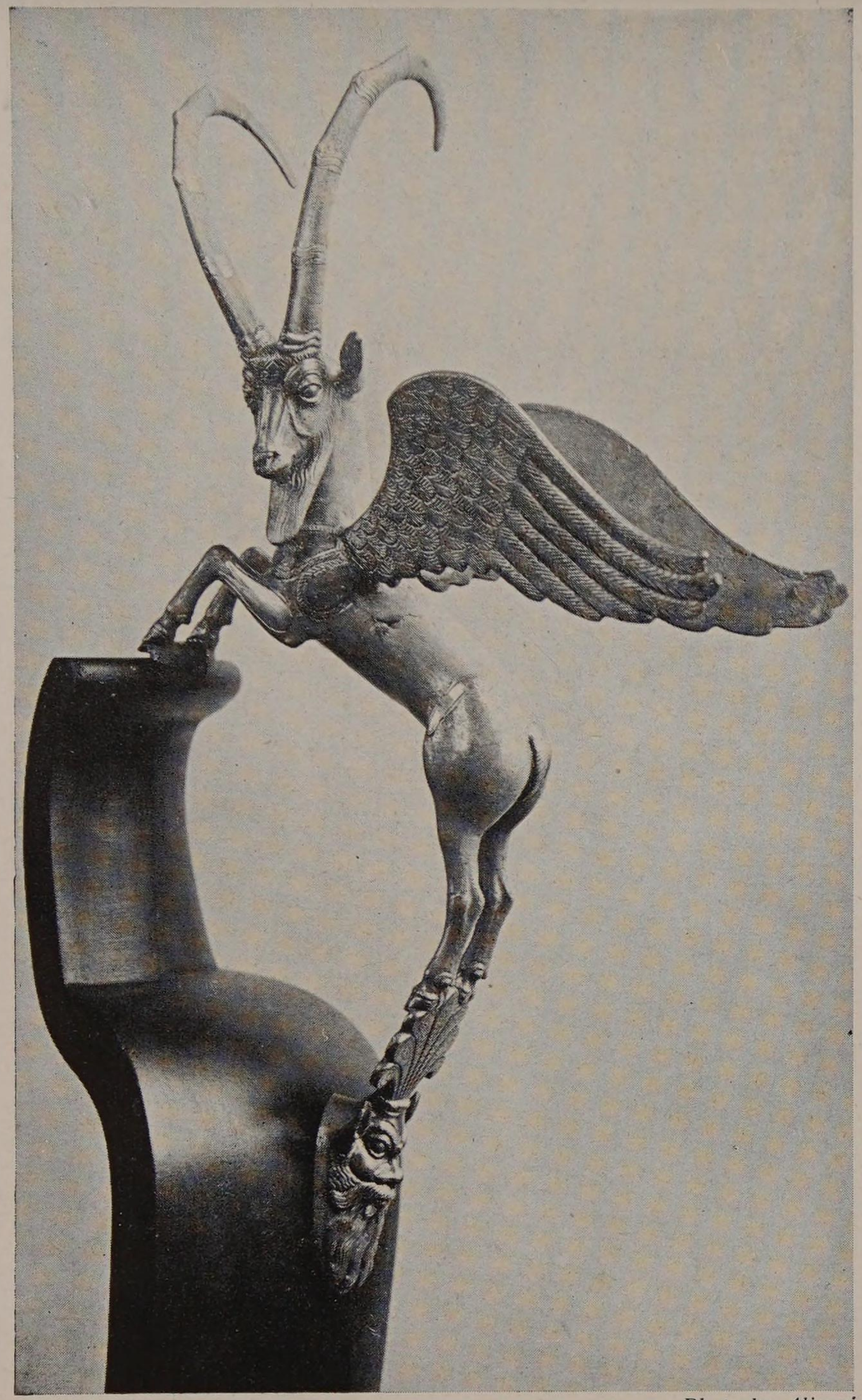


Photo by Alinari

PLATE 188. Antique Vase Handle, *Bronze*



PLATE 189. "Actæon," *Bronze*. Libero Andreotti

While the copper is melting, the molds and core are cooling off. A kerosene torch held near them will cover the surfaces with an invisible film of soot which will prevent bronze from sticking to sand. The core is returned to its place in the center of the two piece molds; the two flasks clamped together once more. The crack between the flasks is now rammed tight, and sealed with a mixture of sand and plaster, to prevent any possible escape of the bronze. The pressure of molten bronze is terrific. Should it find the tiniest outlet, it would burst forth, probably injuring a workman, and undoubtedly ruining both mold and core, and two weeks' work would be utterly wasted.

The mold is set on the floor with the main "gate" uppermost. The crucible of molten bronze is lifted up from the furnace by huge tongs and set into an iron ring which has long handles on either side. By these handles the fiery pot is tipped and the bronze poured in a steady stream until it bubbles to the surface of the gate. Within five or ten minutes, the bronze has hardened. The hot flasks are pried apart with crowbars, the impacted sand broken away, and the mold destroyed forever.

Your sooty little bronze figure stands upside down on its iron rod axis, surrounded by a maze of bronze gates. First the iron rods must be hammered and pried out (a tough business), leaving a hole at either end, and at each side, of the figure. Through these holes the inner core is dug out, bit by bit, with its tangle of wire armature. Then all the gates and vents must be cut off with a hack saw. All trace of sand is removed, inside and out, and the bronze is given a swift bath of nitric acid to remove the black film which covers it. (Heat blackens copper.) Immediately, this acid is washed off with fresh water, otherwise it would continue to eat into the bronze. Now the bronze is ready for the "chaser."

CHASING AND PATINING

The chaser puts the figure into a lead-lined vise and, with fine steel tools and tiny hammers, removes all seams and irregularities from the surface of the bronze. With an acetylene torch he melts the end of a small rod of bronze, and seals up the holes left by the iron rods. With the plaster model to guide him, he checks every detail of the bronze.

When the work reaches this stage, the sculptor steps into the picture again, directing both the chasing and the final patining. Patina is necessary because bronze darkens



Courtesy Metropolitan Museum of Art

PLATE 190. "Heracles," *Bronze*. E. A. Bourdelle

very rapidly and unpleasantly without it. At first a tawny gold, it darkens not evenly, but in blotches. To avoid this, a chosen shade is patined on.

Patining is done by heating the bronze with a gas torch and dabbing on certain acids with a brush. Ferric acid produces reddish-brown tones; copper nitrate makes green shades; silver nitrate gives a light gray. Different combinations of these give



PLATE 191. "American Indian," Detail, *Bronze*. Ivan Mestrovic

different colors. Varying degrees of heat also affect the color. After patining, bronzes are frequently rubbed with floor wax to give a polish, or are occasionally lacquered to prevent air from darkening the color, which is bound to happen in time, especially if the air, as in industrial areas, contains sulphuric acid.

Plates 188 to 191 illustrate sculpture which was especially designed for bronze casting. Only in metal, could the delicate horns of the winged goat have survived to this day. Only in metal could Andreotti's "Actæon" have achieved permanence; those free arms and legs, and the dog's thin tail could not have been rendered in stone, wood, or terracotta. No more could the great bow of Bourdelle's "Heracles." The two spirited Indian and Horse groups by Mestrovic, in Chicago, are notable examples of work *conceived* in bronze.

CHAPTER XVI

IN CONCLUSION

THE student who has read the preceding chapters, describing, for the most part, *final media,* may well be aghast at the tremendous amount of time, hard work and skill which must be expended before a finished creation is ready to be given to the world. Painting would seem to be so much simpler, so much more spontaneous—coming directly from the artist's hand, with no such intermediaries (plaster casters, bronze casters and marble carvers) as the sculptor must frequently depend upon.

Even though the sculptor himself should undertake these final processes—fire his own ceramics, and carve his own wood and marble—the element of *time* then becomes a serious problem. In these days of machine-made efficiency, the art patron who suddenly decides that a piece of sculpture would be a desirable possession expects to have a masterpiece produced almost overnight. There are few who understand the long labor involved in producing truly good work. Being ignorant of the processes, the patron is usually mystified not only by the time he is obliged to wait but also by the amount he has to pay.

As students frequently consult me about the proper charges they should make for their first "professional" work, a few general suggestions here may be helpful.

Roughly speaking, work in the various media may be classed as follows, ranging from the least to the most expensive: Ceramic reproductions, made from plaster piece molds of an original model, cost less than anything else; one can usually produce such a small group or head for about $6 or less. Plaster reproductions, also made from piece or glue molds, are slightly more expensive. Wood carvings reproduced from the original by machine are more costly, but less than bronze casts. Stone and marble carvings are most costly of all, and take the longest time to produce.

There is always to be considered the question of whether the piece is *unique,* and

the mold subsequently destroyed; a *limited edition,* under a guarantee by the sculptor that only so many duplicates will be made; or an *unlimited edition,* the sculptor frankly stating that he intends to make and sell as many copies as he can. Naturally the price must vary accordingly. I have heard several veteran sculptors say that a unique piece should be priced at least three times as high as one of unlimited edition.

For the budding sculptor who has not yet "arrived," there is also usually the difficulty of knowing what to charge some encouraging friend or relative who gives him a commission. Grandma wants you to make a plaque of Aunt Emily, or Cousin Mary wants a tiny portrait in the round of Winkie the fox terrier, to surprise Cousin Bob at Christmas. Obviously the student cannot charge these intimates as much as he would charge the general public. How should he calculate what amount would be fair?

It seems to me that he would be justified in charging (for his ability, training and labor) *double* what the entire undertaking costs him in actual cash outlay. If, for instance, the plaster cast cost him $10, and the bronze cost $30, and his incidental expenses another $10, I think $100 would be a fair price. When the student has reached the professional eminence of exhibiting his work in established art galleries, he should of course charge more, as another factor must be reckoned with—the gallery's commission. Naturally art galleries could not exist unless they charged commissions on the works they sell. Their overhead is usually very heavy. They keep in touch with people of means and taste who may be prospective buyers of sculpture. One may reasonably expect their commission to be anywhere from twenty-five to thirty-three and a third per cent of the sale price. For instance, if a sculptor has made a small figure (unlimited edition), the bronze casting of which cost him $75, the sale price should be around $225, allowing the gallery and the sculptor each $75.

A sculptor's initial expenses are far greater than those of other artists. His materials are costly and often, in order to show his work outside of his own studio, he must first pay to have it cast or carved in an expensive medium, with only a meager chance of selling it later.

In the case of important commissions for portrait busts, monuments, architectural work, etc., the sculptor should always have a written agreement, or such a contract as is approved by the National Sculpture Society. Such contracts are a protection to both parties and are imperative in cases where large sums are involved.

But enough of money matters! No student should ever embark on a sculptor's career if his primary aim is to make money. Sculpture is one of the poorest-paid,

though in other ways most richly rewarding, of all professions. The young sculptor must learn, and learn early, to *do without*. To do without automobiles and fine clothes, to forego all manner of luxuries. Not only because he will not be able to afford them, but because sculpture demands all the concentration of which he is capable.

Gone are the sentimental days of the past century when artists were assumed to be vaguely poetic and effeminate creatures, dreaming their days away, or fitfully inspired by the muse to some sporadic creative fever. We realize today that all artists must be strong, for they must work harder than most men. A young violinist whom I know recently put himself in the hands of a fine teacher. The boy was gifted and ambitious, but anemic, nervous and undernourished. "I will teach you to play when you are *fit*," said the master, "but first you must build up your physique. It takes great strength to play the fiddle well. No weakling can ever hope to control his bow."

Nor can any weakling hope to control his clay or his chisel. The professional sculptor must be prepared to be on his feet all day long, wrestling with obdurate materials. He must also have the moral strength born of self-control and learn to be patient for months on end, waiting for commissions to materialize; and he must be philosopher enough to go right ahead with other work, when they don't materialize. He must be able to bear a whole series of disappointments, for "When sorrows come, they come not single spies, but in battalions." And through each new work he undertakes he must be patient, for the process of working out a problem is a slow one and it is not easy to hold fast to your initial inspiration through all the technical difficulties of armature building, modelling, casting and carving.

It is not easy to discipline yourself to discard what proves to be a failure after you have labored weeks over it; to tear down ruthlessly that which you know is not your best, in order to build better upon the ruins. It is hard not to fall in love with your own work. Hard to stand off and criticize it as though it weren't your very own child.

For you must love the subject to which you endeavor to give expression, or you are not an artist. And loving it, you are so prone to think your own rendering of it must be equally appealing. That is natural and excusable in the young. Later on, a deeper and more mature reaction to the truth, the beauty, or the pitiful ugliness of the subject may well be of a devastating intensity—something that hurts, that explodes inside us—a blinding flash of revelation and perception, a vision of this one truth in glorious relation to all other truths. After such an experience, your own



Courtesy Metropolitan Museum of Art

PLATE 192. "The Hand of God," *Marble*. Auguste Rodin



PLATE 193. "Resurrection," *Bronze*. Libero Andreotti

puny attempts to tell others what you have seen seem futile indeed. No danger now of thinking your own creation pretty fine stuff! And what courage it takes to go on, then!

The would-be sculptor must be prepared, also, to face long periods during which he may have to do "potboilers"—work in which he takes scant interest, but which must be done well, both because his future career is at stake and because, as an artist, he is too honest to turn out slipshod work. Even if such labor is at first utterly distasteful to us, there are ways, if we try, of overcoming our aversion and eventually actually enjoying what we are doing because we know that we are doing it well. For after all, in such work it matters not nearly so much *what* one does as *how* one does it.

Do not misunderstand me if I seem to imply that technique is always to be put before everything else. Far from it. But in "hack" work, honest craftsmanship can certainly save us from utter disillusion and disgust with the career we have chosen. It is a lifesaver for one's artistic conscience.

But at other times, when we are doing the creative work we love and trying to contribute our small part to the imaginative beauty of the world, technique must be entirely subordinated to the message, if our creations are to fulfill their mission and give others a share in the vision that inspired us. Who but an artist of rare sensibility and deep imagination could have conceived Rodin's "Hand of God"? (Plate 192.) Who but a man of innate nobility and transcendent faith could have created Andreotti's "Resurrection"? (Plate 193.) We do not think of their technique when we study such work. That is totally forgotten amid the thoughts and emotions evoked by the message.

Nor did such men have to look far afield for their inspiration. In themselves they were great enough, broadly human enough, to appreciate and express for us life in all its phases: the exalted, the humdrum, the lovely, the grim and the humorous.

And how sorely needed is humor in art! We sculptors need a sense of humor every day to help us over the rough spots. And what an evident delight it is to our public to discover, amid an exhibition of somber and soul-tortured groups, some whimsical absurdity that proves that the sculptor is after all human and can see a joke as well as they!

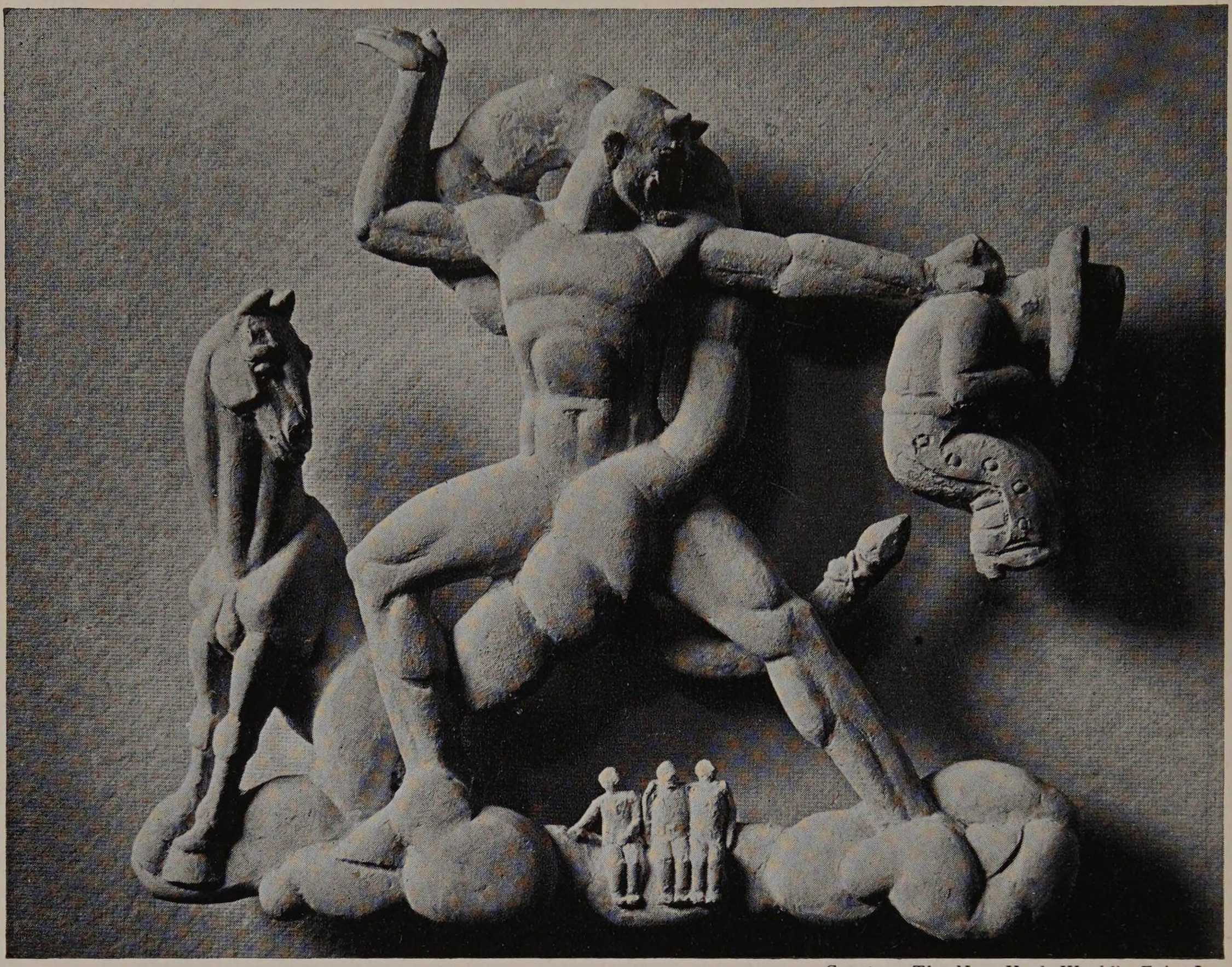
Undoubtedly, of all our media, ceramic art holds infinitely more possibilities for humor and fantasy than any other branch of sculpture. Here the sculptor can "let loose" and thoroughly enjoy *playing* with his material. Animals, especially, lend themselves to the lighter touch. For most of them are, or can be made, as nonsensical as the sculptor chooses. Penguins and pelicans, wart hogs and camels, hippopotamuses and



PLATE 194. "Jonah and the Whale," *Bronze*. Carl Milles

kangaroos—surely all are fantastic enough to challenge the sculptor's imagination and sharpen his wit!

Nor need man himself be omitted from the category of strange beasts on this earth. Not only man, but his experiences and the legends that his imagination has invented, are full of amusing possibilities. Perhaps no one has been more skillful in catching some of these quainter and more fanciful aspects than Carl Milles, the bril-



Courtesy The New York World's Fair, Inc.

PLATE 195. "Strap Buckner and the Devil." Edmond R. Amateis

liant Swedish sculptor who has come to live among us, and has enriched and gladdened us with such delectable bronzes as the "Jonah" fountain in Cranbrook (Plate 194). Milles is a master sculptor who can be vastly serious and dignified when he chooses (as in his "Orpheus," or the recently completed "American Indian" in St. Paul). He also has a rare gift of communicating to others his joy in the fantastic side of life. Folklore, perhaps especially Scandinavian folklore, is replete with naïve humor and grotesque imagery, and to Milles we owe a debt of gratitude for letting us savor its salty tang.

Why should not the American sculptor do as much for his own native and picturesque folklore? Both at the Texas Centennial of 1937 and at the New York World's Fair of 1939, some of our ablest sculptors *have* used just such material as themes

for their designs (Plate 195). To my way of thinking, this is one of the healthiest and most hopeful manifestations in American art today. For folklore, like the "musick" jolly old Handel was moved to write, is "immediately understanded of the people." Through it, without sacrificing one atom of their artistic integrity, our younger sculptors may find one way of bridging the unfortunate and unnecessary chasm now existing between the people and the artist. Humor in art need not be flippant or trivial. The great composers are neither when they incorporate a madcap scherzo in their symphonies; the scherzo is introduced as a foil to the pensive or melancholy slow movement. Each enhances the charm of the other. The musician is sculptor enough to understand the value of light and shade. They are an essential part of the design, which in turn is a personal interpretation of life, brought into spiritual and harmonic unity by the art of the composer.

Perhaps the analogy is not wholly appropriate, however, as sculptural unity is not quite the same as the unity of the component parts of a symphony. Sculpture is rather the unity, the singleness of purpose and of mood, of the tone poem.

Conflicting emotions in any one piece of sculpture would be bewildering to the beholder. In music, the various moods have sequence; they follow each other; the first mood has already passed beyond hearing before the second makes itself felt. But herded together as they would necessarily be in sculpture, all demanding attention at one and the same time, they would disastrously complicate matters. Such complication would certainly be far from the true aim of sculpture, which is rather to simplify, to clarify, to magnify from the particular to the universal, some one aspect of life.

In the introduction to his recent book on wood carving * Alan Durst, the English sculptor, has epitomized for us in a few telling lines what should, I believe, be the primary aim of every artist:

"The artist tries to interpret life in terms of order; to hold some one aspect of the ever-changing and bewildering vision around him in a permanent design; to find harmony amid confusion; to discover a resting-place for the mind. The search for order is ultimately the search for truth."

* Alan Durst, *Wood Carving,* The Studio Publications, Inc., New York.

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THE author acknowledges with deep gratitude the generous contributions by her colleagues of Chapters XII, XIII, XIV, and XV, without which this book would be sadly incomplete. Each contributor is a specialist in the particular field covered.

Carl Walters, a native of Iowa, now residing in Woodstock, New York, is becoming widely known for his researches and achievements in ceramic sculpture. His work is to be seen in every important exhibition of contemporary ceramics; his talents have twice been recognized by a Guggenheim Fellowship. He is represented in the Metropolitan Museum, the Museum of Modern Art, the Whitney Museum, and the Chicago Art Institute; also in the museums of Minneapolis, Portland, Detroit, Cincinnati and Davenport.

Robert Alexander Baillie, born in Scotland, son and pupil of a master carver, has his studio in Closter, New Jersey. Few are the sculptors who have not had at least one carving from his chisel. Among other works too numerous to mention, he carved Malvina Hoffman's "Crusader" in the Harvard Memorial Chapel, Cambridge, Mass.; the heroic "Man and Horse" group by Anna Hyatt Huntington at the Marine Museum, Newport News, Virginia; and the author's figure of "Puck," Folger Library, Washington, D. C.

Gleb Derujinsky, one of our most gifted sculptors, was born and had his early training in Russia. The revolution brought him to this country, and since then he has lived in New York City. For years he has made a specialty of wood carving. He is a member of the National Sculpture Society, and an Associate of the National Academy, which recently awarded him the coveted Watrous Gold Medal for his heroic figure "Upheaval." Examples of his work are to be found in the Metropolitan Museum, the San Diego Museum, the Toledo Museum, and at Cranbrook Foundation, Michigan.

Anton Basky, hailing originally from Hungary, worked in Paris before coming

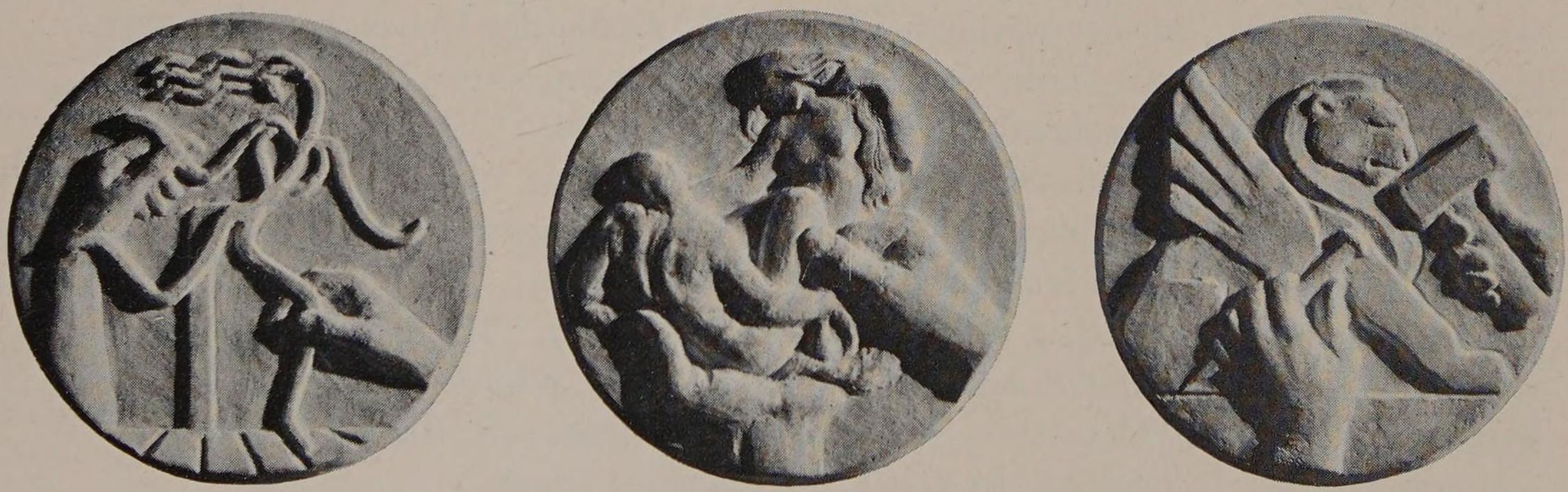
to this country. He worked for a number of years as assistant to Karl Bitter, Charles Niehaus, and other well-known sculptors. Returning to France, he worked as marble carver for Rodin. Back again in the United States, he perfected himself in the technique of bronze casting and opened his own New York shop, complete with foundry, carving, stone-casting and plaster-casting facilities.

To Dr. Armitage Whitman I am especially indebted for his expert criticisms and suggestions relative to the chapter on anatomy; and to Dr. Walter L. Hervey for his erudite and stimulating aid in helping a sculptor with the unfamiliar medium of the written word.

To my pupil, assistant, and colleague, Marion Sanford, who has so painstakingly rendered in black and white the many sketchy penciled diagrams with which my manuscript was strewn, I shall always be sincerely grateful. And to the photographer, Ernestine Shepard, who has labored with me over a period of years taking most of the *demonstration* photographs for this book, my most appreciative thanks.

Thanks are due, also, to the publishers George Bell & Sons, London, for permission to reproduce illustrations from Walter Crane's *Line and Form;* and to the Studio Publications for permission to quote from Alan Durst's *Wood Carving.*

Finally, or perhaps primarily, I owe a debt of gratitude to all those eager students whose passionate and determined search for knowledge and truth led me to write this book.



"Armature" "Modelling" "Carving"

PLATE 196. Medallions. Brenda Putnam

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