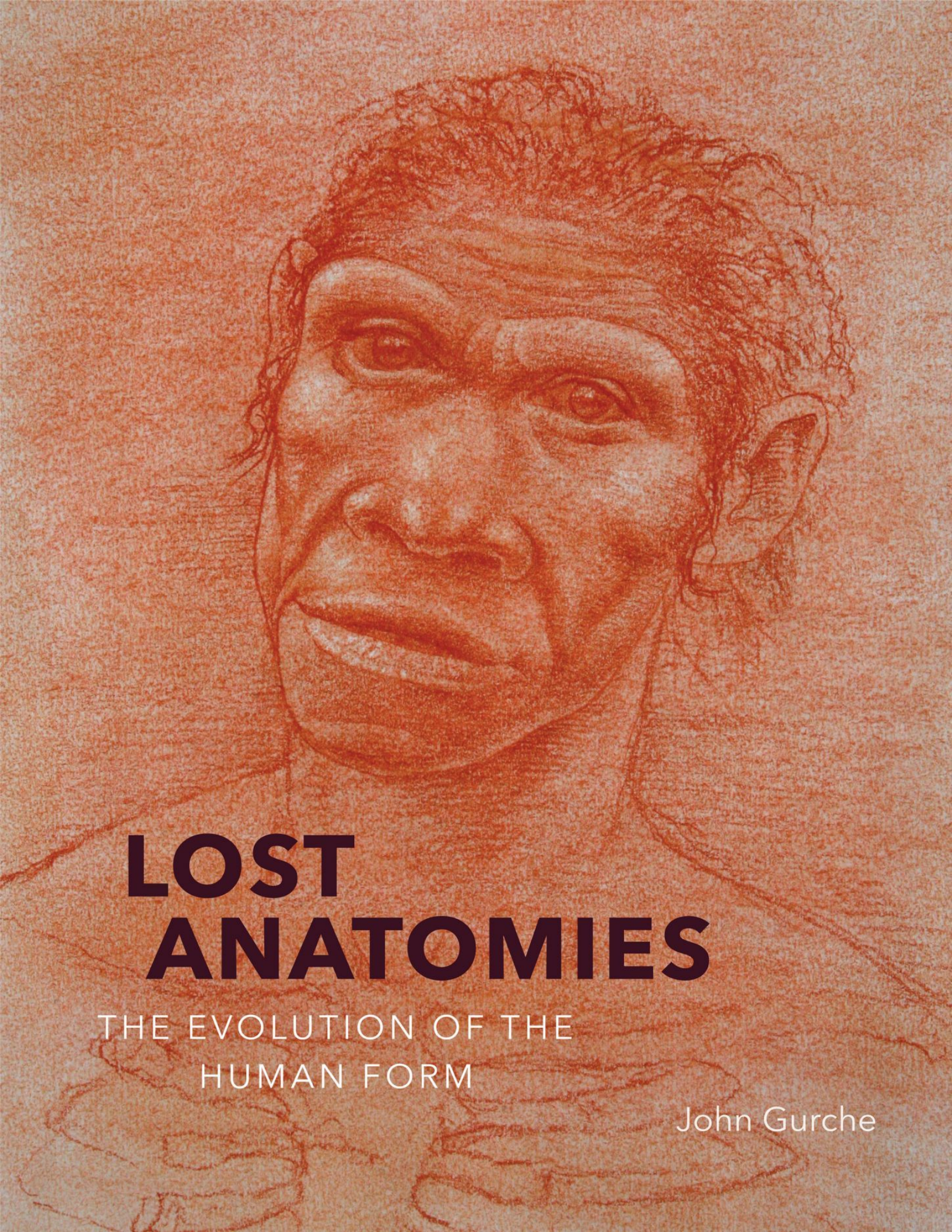
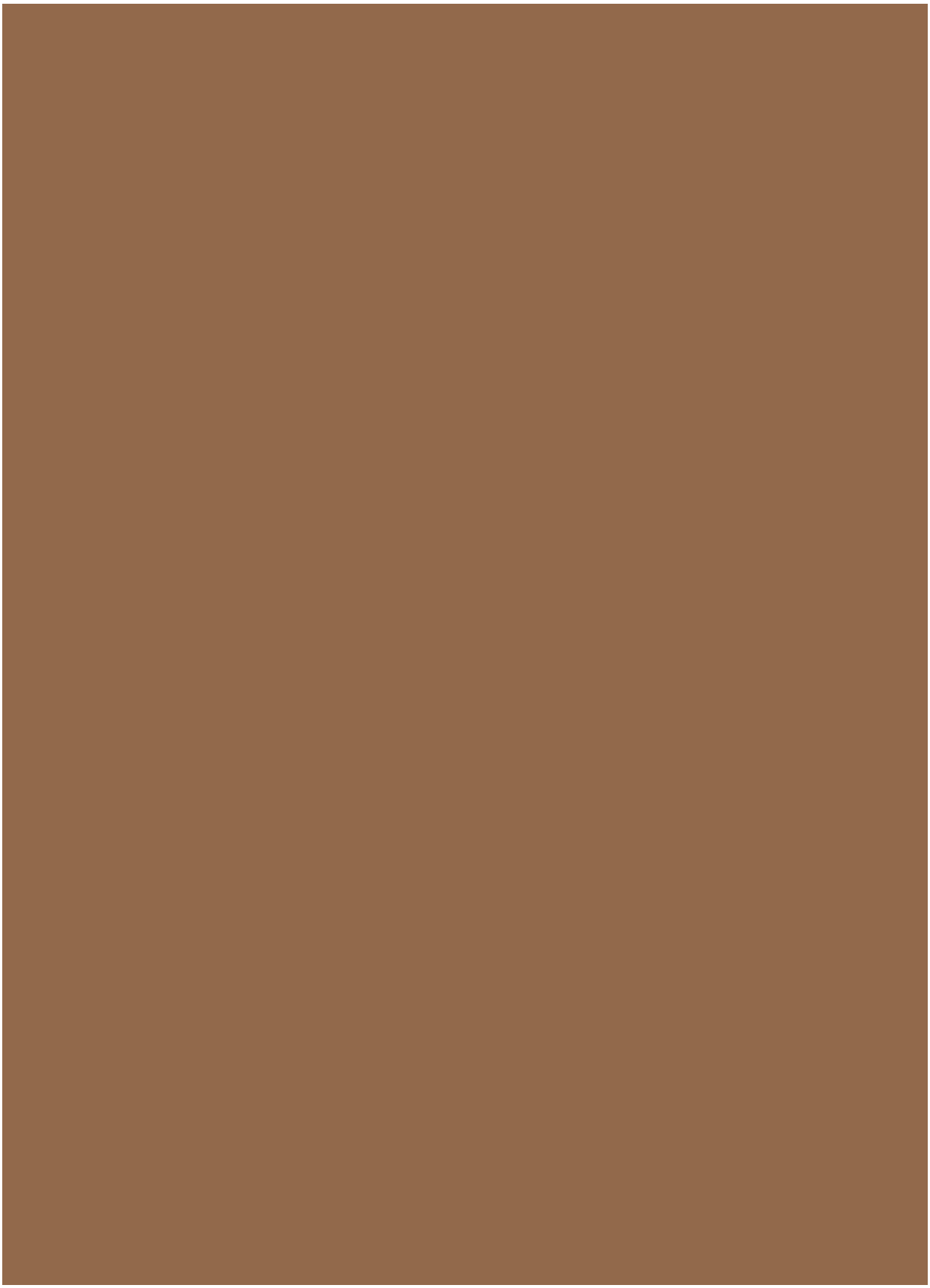


LOST ANATOMIES

THE EVOLUTION OF THE HUMAN FORM

John Gurche



John Gurche

LOST ANATOMIES

THE EVOLUTION OF THE HUMAN FORM

FOREWORD BY Meave G. Leakey

ESSAYS BY David R. Begun, Trenton W. Holliday, Rick Potts, and Carol Ward

ABRAMS, NEW YORK

In loving memory of my parents, Jack and Suzanne Gurche

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FOREWORD

Meave G. Leakey

I vividly remember my first interaction with John Gurche and his art. We were camped near the lakeside at Allia Bay on the rather desolate eastern shores of Lake Turkana in northern Kenya. Our mission was to explore the ancient sediments nearby that we hoped would give us more details of our early ancestors at a rather poorly known but significant time—one that witnessed the appearance of manual dexterity and bipedal walking in our ancestors. We had recently discovered some hand bones in an excavation close to our camp and John began by skillfully drawing the hand bones and with them reconstructing the hand. His images clearly showed how these ancient bones shaped this early human hand. I was fascinated by his illustration, rapidly developing through his artistic talent. This brought home to me the power of art in elucidating an ancient fossil's shape and function. As John sat in our comfortable camp sketching, I was intrigued by his skillful rendering of our new finds, and his projections of these fossils, into a reconstructed fully functioning hand.

Over the last fifty years, often for weeks at a time, I have wandered the barren badlands of the Turkana Basin in northern Kenya searching for evidence of our ancestors. We have found many beautifully preserved fossils, as well as many that are little more than fragments. But they all have a story to tell. Deciphering this story is immeasurably satisfying and even addictive. But explaining to others the implications of each fossil is often deceptively difficult. John Gurche has chosen art as a medium to do this and the compilation of his art in the pages that follow demonstrates how successful a medium this can be. John's artistic renderings of many carefully chosen fossils cannot fail to instill in the reader a sense of curiosity about our past.

This book, with its compilation of artistic renderings of fossils that tell the history of our development from an ancestor just beginning to adapt to a bipedal lifestyle, to the fully bipedal manually dexterous species that we are today, provides a vivid picture of our evolution over the last six million years. Art is a powerful medium that can replace thousands of words in demonstrating both function and evolution. This beautifully illustrated book does just that.

Page 1:
Australopithecus afarensis male. Acrylic and graphite on acrylic- and sand-washed board.

Page 2:
Homo sapiens and ***Pan paniscus*** (bonobo) hands. Pen and ink with graphite on acrylic-washed board.

Page 4:
Homo sapiens and ***Pan troglodytes*** (chimpanzee) males. Digitally altered graphite drawings.

Opposite:
Australopithecus (species unknown) reconstructed hand skeleton. Graphite on acrylic-washed board.

INTRODUCTION

John Gurche

Science and art—are they strange bedfellows? They are so different in their methods and their goals. In spite of this, or perhaps because of it, the idea of blending them is intoxicating: the visions that can spring up in making art, fueled by the potent revealer of worlds that is science.

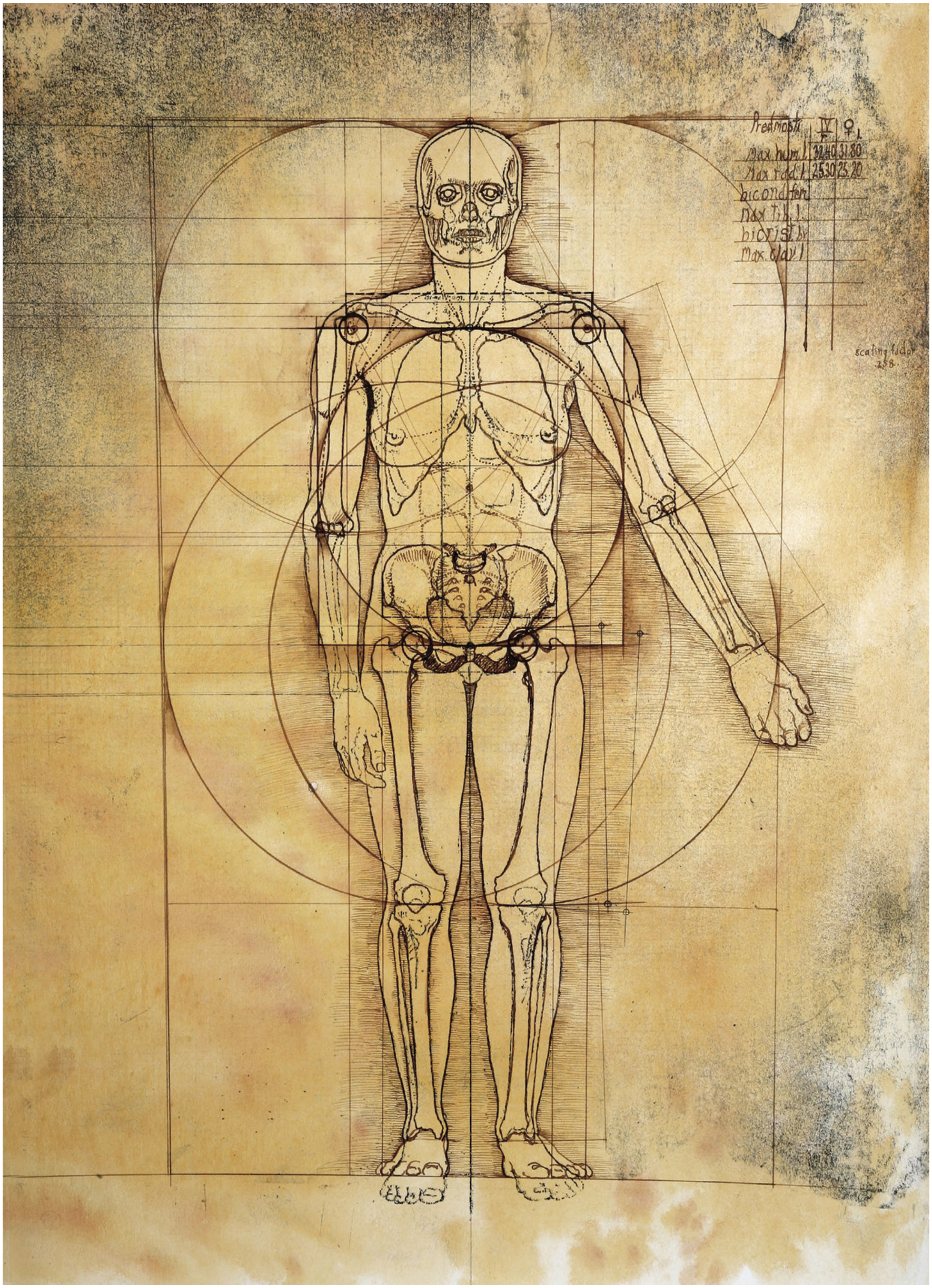
We make art about portions of nature that affect us powerfully. This is arguably true even for abstract art, where the part of nature in question is the inner landscape of the artist's own soul. For many of us, the human form is at the top of the list.

Fascination with the human form has fueled exploration by artists for millennia. We now live in a time when the scientific study of human origins has extended the field for such work by revealing the precursors of the human form: the body shapes of our great ape ancestors and our extinct human ones. These, too, are ripe for exploration in art. Thus, science-enabled art joins the long tradition of nature-based art, extending our vision of human anatomy into the deep past. Here, the portion of nature being explored by the art is one we can see only by the lights of science.

You gaze at the body of your lover who lies facedown on the bed. The soft light of a candle illuminates the concavity of the lower back, the curve of the buttocks. And you respond. Why does the small of the back or the curve of buttocks look so perfect to us, whether in a sexual context or when we view sculpture at a museum? Among animals living today, these features are unique to humans. If you were a blue-footed booby, it would be those blue feet that entrance you. But you are a human, and you respond to the body shape of your species mates: the human form.

For Leonardo da Vinci, the proportions of the human body harmonized with the cosmos. His drawing *Vitruvian Man* associated the human form with the circle and the square. While there are many mathematical ways to relate the circle to the square, in Leonardo's drawing they are related only *through* the human form. The same human figure whose height is equal to the span of both arms—establishing the dimensions of a square—has limbs that, when further extended, form a circle with its

Homo sapiens female body proportions, based on the Předmostí 4 skeleton. Pen and ink on acrylic-washed board.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center at the figure's navel. The human form, as the key to this relationship between simple geometric figures, seems to join their ranks as a fundamental element in the design of the universe.

According to some religions, humans were made in God's image. We often find this idea expressed in art; the bodies of God and Adam as they are portrayed by Michelangelo on the ceiling of the Sistine Chapel are very similar. While I'm not arguing for the divinity of the human form or implying that it has the status of an elemental geometric figure, its treatment by artists suggests the strength of its hold on us. It has surely been one of art's most powerful subjects. Given this legacy, artistic exploration of its coming-to-be seems imperative.

Ever since I first realized what a fantastic and bizarre development the origin of humanity was in the history of life, I've wanted to know our human ancestors. In a quest for their identities, I wanted to see their faces, gaze into their eyes. Since they are, at the moment, indisposed, the only path available is to use what we know about comparative anatomy to rebuild their faces over their skulls. I couldn't learn how to do this in art school. But I continued into adulthood my childhood practice of drawing and sculpting whatever fascinated me, and I combined that with academic training in paleontology and anthropology. And after that, I spent decades working with teams of scientists to discover patterns in the relationships of bone and soft tissue in modern apes and humans that could be used to extrapolate soft tissue anatomy from bone preserved in fossils of extinct ancestors.

Looking back, I can only be grateful for some of the experiences this path opened up to me.

I have sat at a table with a 2.5-million-year-old skeleton laid out before me, pondering the shape of this creature that was human in some ways but far from humanity in others.

I have carefully teased out, from fat and fascia, fibers of the muscles of facial expression in an adult male orangutan, until the structure that emerged looked like a bizarre sculpture of an ape's head in the process of becoming a flower, the muscle fibers fanning out like elongated petals across the backs and fronts of the large fat pads on either side of the face (page 30).

I have discovered a stone handaxe nearly a million years old eroding out of a hillside, realizing as I grasped it that the last hand to hold it was not fully human.

I have stood above a pristine human cadaver, thinking, I can't do it, I can't cut into this. When I've finally overcome my hesitancy, it hasn't taken long for me to enter a different emotional stream, as my scalpel begins to reveal the complex structure that underlies the form.

What artist could have such experiences and feel nothing? A sort of aesthetic pressure began building in me as I worked on the anatomical science behind hominin reconstructions, until I couldn't stand it any longer and, twenty-seven years ago, began working in private on a collection of art about human origins that had aesthetic goals as its primary concern. Since then, I have stolen time for it whenever I could. The result is the art in this book.

Apes, angels, and monsters fascinate us because they seem to be aberrations of the human form. Even if some of these represent our predecessors, the human form is our frame of reference, and we measure everything against that. What a thrill to discover a process that can reshape a form that reads as "not human" into one that whispers to us, "human." If the experiences described above have a common element, it is that they flirt with the boundaries of familiar territory—forms we all have deeply burned into us. Humans do not, of course, have huge fat pads flanking our faces, but we do have fat-enhanced cheeks, and we are fascinated by facial structures that are so different in form from our own. And the arms! Can they really be that long? The feet shock us with their resemblance to hands; they function as grasping organs in addition to their role in supporting the body's weight. Looking at these extremities, we may not at first realize that these are the original forms, and ours the derivation.

What methods can best express these forms and their elements in art? Of all the two-dimensional techniques used to capture anatomical forms, drawings are, for me, the most moving by far. Michelangelo supposedly had most of his drawings burned. He apparently wanted people to see only his finished masterpieces, in sculpture and paintings, but not the steps that led to them, with their roads not taken, blind alleys, and wrong turns. For me, the drawings by Michelangelo that survive and the drawings of Leonardo and Albrecht Dürer have always been these artists' most vibrant, compelling works. The final painting may be a beautiful facade of perfection, but you don't see as much of its creator in it. The drawings are nothing less than thought on paper. The human form is there, along with a thrilling glimpse of the medium through which it comes to us—the mind of the artist. Wishing to include in the art for this book something of my process in reconstructing anatomical forms for extinct ancestors, I have chosen drawings. I use the word loosely, and did not disqualify a piece if, for example, paint began to dominate ink and graphite, as long as the work made visible hints of its process.

Aesthetic goals may be dominant here, but science is still important to the art in this book. Each of these drawings is based on a careful reconstruction of a particular fossil, using the best anatomical science available. Most of the anatomical forms depicted in this book have come down to us in incomplete form, and to see them whole again it is necessary to restore their "lost" anatomies using our understanding of anatomical relationships in living forms. While reconstructing the anatomy, it is important that I restrain my aesthetic impulses. Then, when the reconstruction is completed and I want to draw it, I let these feelings out of their cage. But they are on probation; many alterations of lighting, color, perspective, and so forth, are permissible in the name of aesthetics, but anatomy may not be misrepresented.

Some of these drawings do not stop at "pure" visual description of anatomical forms. Other elements have crept in. How to account for these? I'm not certain that I can clarify my process completely. I'm not sure any artist can. I'm tempted to say: *Never trust an artist who says he can fully explain his process*. We can tack on a rational explanation after the fact, but art making is essentially a nonverbal behavior,

influenced by forces at the edge of conscious thought. Maybe I shouldn't try. It's reported that Stanley Kubrick once said: "How could we possibly appreciate the *Mona Lisa* if Leonardo had written at the bottom of the canvas: 'The lady is smiling because she is hiding a secret from her lover'?" Better to reflect on the mystery of Leonardo's thought process. Even Leonardo may have had trouble spelling out exactly why he painted as he did.

All I can say about my own work is that, in the execution of these drawings, something else often took control of the process–something that felt like it came from outside me. Somewhere along the line, a radical turn not in the original plan would assert itself with increasing insistence, and I sensed that the drawing *wanted* to go there. I know that sounds a little silly, but that is truly the way it felt. I had a choice: to follow or not. Here is a description of the process for one drawing (page 12), which I wrote shortly after its completion in an effort to understand it for myself:

> *The bones from the Kebara site just wouldn't stay still, that was the thing. At first, it was enough that the skeleton was found in a position that made for a powerful composition, and this was my motivation for beginning the drawing. There was a great deal of particulate matter found with the skeleton, pieces of bone and sediment, and I decided that these should be included. I did not at first realize that they would hijack the process. So I finished the drawing, and it was a perfectly decent drawing of the bones in a dynamic composition. This was somehow not enough, and the particulate matter especially was crying out for further exploration. I needed to make myself small, to dive into the drawing and explore. So I scanned the drawing and blew it up to a much larger size. I was enthralled by the motion implied by the distribution of the particulates; they seemed to be swirling about the skeleton. Heeding the call to augment this effect, I began to alter the image to increase the impression of movement. At some point, the drawing began to demand color, and the particulates became like some kind of impossible, hypothetical stars that are red-shifted at one end and blue-shifted at the other because of their motion. Magenta is not one of my favorite colors, but the drawing was now demanding colors that were electric, even neon, and the strongest candidates were magenta above and an electric blue below. In this way the inanimate becomes the animate.*

Ought I to have refused to go down this path? In the name of what, exactly? Purity of representation of the original form of the skeleton as it was discovered? I'll admit that the power of the original form was strong, and I risked making it quite a bit less powerful with this experimental path. But there was the irresistible possibility of making it even stronger. The skeleton is almost dancing, with the particulates whirling about it, generating smoke with their frenetic agitation. It is vibrating–a motion that suggests life.

The ancestors pictured here have made the long journey into our time in an incomplete state; they come through only with a high noise-to-signal ratio. Erosion

The Kebara skeleton of ***Homo neanderthalensis,*** as discovered and before excavation. Iron-on transfer of graphite drawing, with acrylic on board.

and decay have done their work, which is sometimes represented in the drawings by visual static—the textures of sediments representing the enormous amount of time that separates us. The ancestors' gazes are locked with ours, but only across oceans of time and sediment. Some of the drawings in this book represent a quest for the perfect balance of noise and signal.

I've sometimes included in a portrait extracts from the anatomical notes I made while reconstructing an ancestor. These, too, have a part to play in its journey from living being to fragmentary fossil, to our best idea of its form reconstituted. Some of the images are straight out of my anatomical notebooks, either digitally manipulated or unaltered.

There are occasionally intrusions of the surreal here. I may want to suggest a subjective reality as it might have been experienced by a particular early hominin, a creature that has some of the qualities of being human but not all. Several of these works might be titled *With Enhanced Cognition Come New Horrors*. I would argue that any attempt to capture the subjective experience of a member of a species different from our own must have a surreal quality to take us out of the confines of our own experience.

The art in this book is presented in four chapters, reflecting taxonomic categories that our closest relatives easily fall into. These represent four broad phases of human history. In "Apes and Earliest Hominins," the earliest hominins are included with the apes because they are very ape-like, so much so that the hominin status of each has been questioned (there is growing consensus, though, that they *are* hominins). "Australopiths" records a phase of human history in which adaptations to bipedal walking and running really came into their own, in bodies that were still capable of tree climbing. "Archaic *Homo*" covers the origin of our genus, which evolved bodies that were adapted to increasing carnivory, long-distance travel, and growing dependence on stone tools. Brain enlargement and enhanced cognition are part of this picture. These adaptations seem to have been present to varying degrees in species of archaic *Homo,* but by the end of the chapter bodies look nearly modern (though brain size lags behind). With the species described in "Derived *Homo*," brain size reaches the modern range and bodies become fully human.

Moving through the book should engender a sense of gathering humanity. The evolution of the human form was a mosaic process, with some of the features we consider quintessentially human evolving very early in the history of the hominids, and others quite late. Evolutionary cousins that were not our ancestors are included in order to avoid any misperceptions of linearity in the human tree.

It is important to understand that, although the forms of our ancestors may seem to be moving with purpose toward our own form, evolution never had the human form as its goal. Evolution has no goals: If something works well enough in the local environment to allow its possessors to survive and reproduce in greater numbers than individuals who don't possess that something, that feature is selected for. If that something continues to convey an advantage over long periods of time, it might mark an evolutionary trend—enlarging brains, for example—that appears to

be purposeful. But nothing in the human form was ever an intended end point—it is simply the form we find to be our own in the era in which we live. Those bigger brains have worked well in our time. So far.

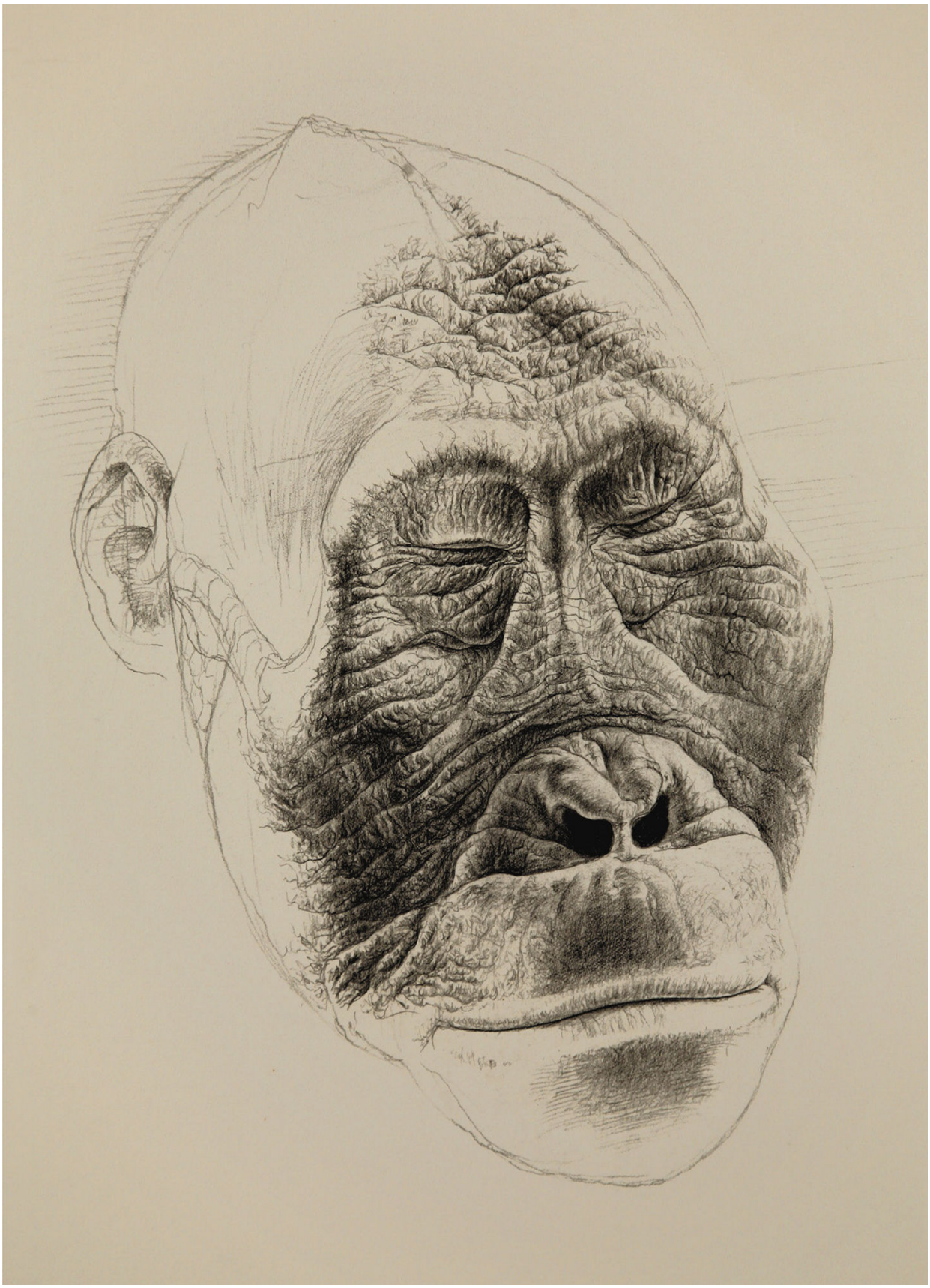
The human form resonates so strongly with us that we may be tempted to see it as a finished creation. We do not usually think of it as dynamic and ever-changing, a thing worked and reworked over time. But evolution is a restless sculptor, rarely content to let a form remain as it is for long. In fact, the body we call human has been remodeled many times and for many different functions. When you look at the exquisite red chalk drawing of Adam that Michelangelo made in preparation for the fresco in the Sistine Chapel, you are looking at an arboreal great ape's body that has been reworked for bipedalism on the ground and for a technology-enhanced life in a multihabitat milieu. If we survive, the body will be made over again.

When I thought about the ideal writers to introduce the ancestors represented in each chapter, my decision came down to a few simple questions: Who knows them best? Who loves them best? While the public might have an idea of scientists as purely dispassionate observers, this is rarely the whole story. Many scientists are motivated by factors that can only be called aesthetic. For this book, I am fortunate to have found scientists who excel at two things. They are among the world's leading experts on the groups they study. And they see the poetry beyond the numbers.

This collection has been my labor of love for twenty-seven years. The research behind it has taken me around the world, from Kenya and South Africa to France and the Republic of Georgia, to study original hominin fossils. Equally important is my more than thirty years of dissecting orangutans, gorillas, humans, bonobos, and chimpanzees. To see what I have seen is beyond any dream I could have had for my life early on. It is my fondest hope that these drawings will do some justice to the anatomical magnificence and visual power of the evolving human form. As you travel among the heads and faces, hands and feet, skeletons and musculature—the once-lost anatomies depicted in this book—I hope you will find some visions that awaken an interest in the long journey of humankind. If you experience even a small part of the joy I've had while making these drawings, I am happy.

David R. Begun

1 APES AND EARLIEST HOMININS



Previous page:
Sivapithecus indicus. Graphite on board.

Opposite:
Pan paniscus adult male. Red chalk on acrylic-washed board.

Most people love pictures of baby great apes, with their round, hairless heads and big, forward-facing eyes. They are adorable and look remarkably like human babies. I love these images, too—cuter than cat videos on YouTube. But, as great apes grow, they look less human, and people tend to see less of a connection to themselves. I see more of a connection. I see not the humanity of apes but the "apeity" of ourselves. This is why, forty years ago, I began to look seriously at the fossil record to better understand the relationships between apes and ourselves.

The power and majesty of a big male lion or a bald eagle impress us, but, while aesthetic on one level, these creatures bear no fundamental connection to us. Look, however, at the living great apes and you will see that we are just another one of them. The wise gaze of a bald, wrinkly old female chimpanzee and the confident, calm expression of a big male silverback gorilla are tellingly familiar. I am struck by two of the *Pan paniscus* (bonobo) images in this book, the male looking as if he is concentrating on the starting gun ahead of a four-hundred-meter relay race (page 18), and the female waiting patiently for John to call a break from the portrait session (page 39). These images are not meant to represent apes acting like humans. But they are so human, or we are so ape, as to make the connections unmistakable. We do not know what they are thinking, or even if they are thinking, but the faces they make are like our own, more so than the faces of any other animal. As this book brilliantly shows, our faces resemble those of great apes in large part because of all the muscles we share with them. However, there is something else: It's the precise combination of the contraction of some facial muscles and the relaxing of others that makes a particular facial expression, whether a smile or a grimace, so recognizable in great apes. It is hard to believe that this degree of muscular control, hard-wired to ancient connections in the brain, does not reveal some of the same emotions we recognize in our own faces.

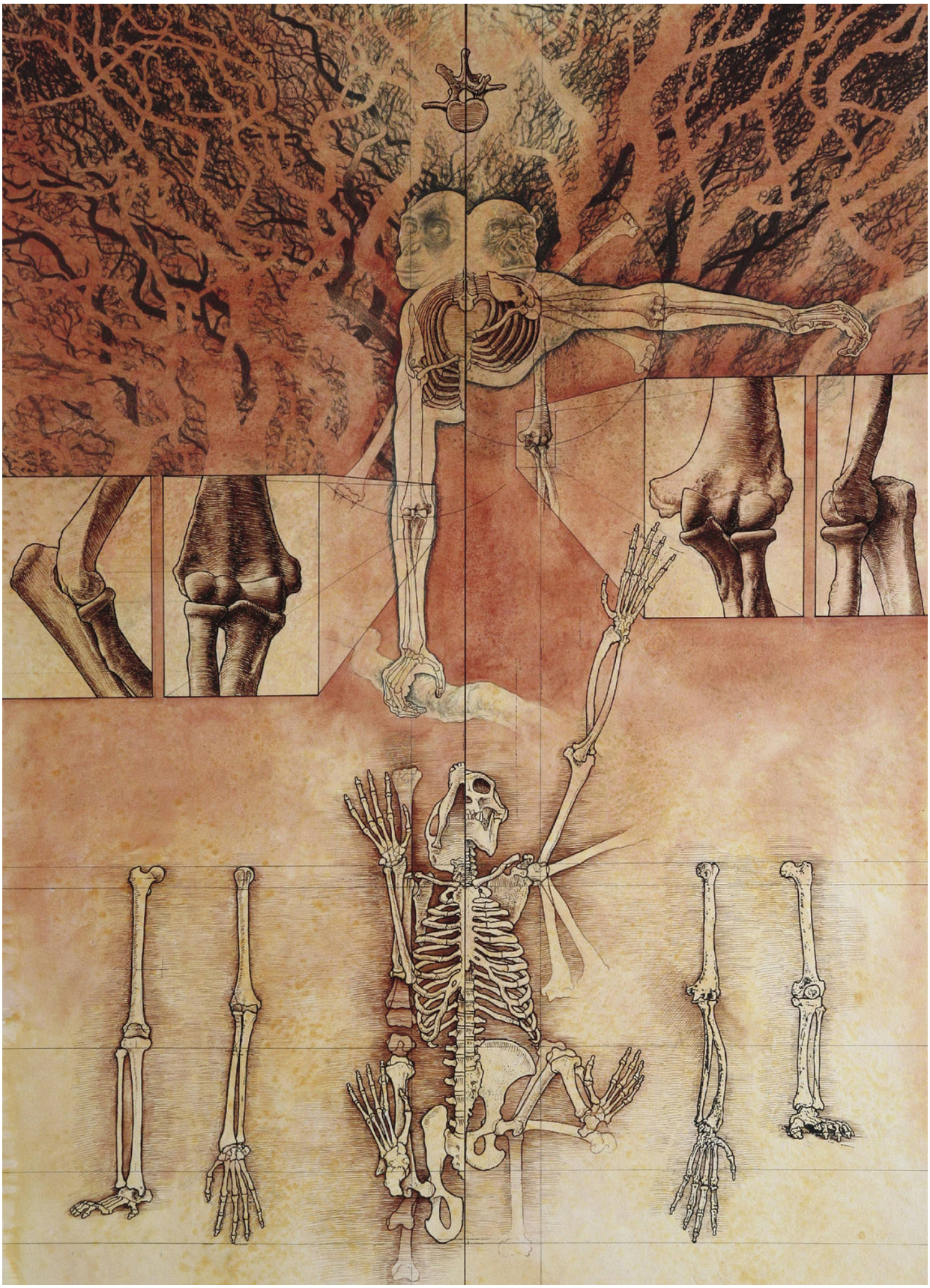
Body plans of an archaic ape (***Ekembo,*** left) and a great ape (chimpanzee). Graphite and pen and ink on acrylic-washed board.

That humans evolved from a chimp-like ancestor might seem self-evident, but among paleoanthropologists this is far from the case. While there is no scientific dispute that we share a common ancestor with chimpanzees, there is intense debate about the nature of the last common ancestor, or "missing link," between chimpanzees and humans. The reconstructions in this book of our ancient relatives *Sahelanthropus* or *Ardipithecus*, for example, make you think great ape, not human. Meeting these guys on the street, you would call the cops to report an escape from the zoo. It is one of the great mysteries of paleoanthropology that the human lineage has changed much more than chimps have since our divergence from the common ancestor we share. Having changed less, today's apes are to some extent living fossils, providing a window to understand the nature of our ancestors.

The great apes include the orangutan, gorilla, bonobo, and chimpanzee. All apes living today are found exclusively in the tropics. In Asia, there is the orangutan of Sumatra and Borneo, and in equatorial Africa there are the chimpanzee, bonobo, and gorilla, spread across the continent from Tanzania in the east to Senegal in the west. All great apes are facing extinction from competition with humans. Your children or grandchildren may never know the reality of great apes in their natural habitat. But that is a topic for another book.

All great apes have longer arms than legs, in contrast to monkeys and some extinct archaic apes like *Ekembo* (opposite), most of which have limbs of roughly equal length. Humans, of course, have longer legs than arms, related to human bipedalism. Great apes' long arms make them excellent climbers, able to reach onto branches from below. They swing from branch to branch rather than walking on top of the branches, as monkeys and archaic apes do. All great apes also have a more vertically oriented backbone than monkeys and archaic apes, which, like most mammals, have horizontal backs. Great apes have broad torsos, and they hold their arms to their sides rather than, as in most mammals, underneath their bodies. The great ape's elbow has special attributes that allow it to swing below branches. Unlike monkeys and archaic apes, great apes can extend their elbows to fully straighten their arms and have very mobile shoulders and a wide range of motion of the hand. These attributes are beautifully illustrated in the image (page 21) comparing the skeletons of a chimp and an archaic ape (*Ekembo*). Finally, great apes are big primates, ranging in size from about 30 kilograms for the smallest chimps and bonobos to more than 150 kilograms for big male gorillas. They take longer to reach maturity than any other primate except humans, sharing with us a long period of infant dependency. Great apes are the only living primates that overlap with modern humans in body size.

Of course, great ape bodies are not identical to ours. Our short hands (especially our short fingers) and large, powerful thumbs confer on us a much greater degree of precision in our manipulative abilities. Our shorter, wider feet, with their enlarged anklebones, massive big toe, and tiny little toes, have turned the manipulative organs of apes into stable platforms for efficient bipedalism. Our long legs further increase the efficiency of our bipedal gait, as does our longer, narrower trunk.



Nevertheless, the attributes we share with the great apes are many and without a doubt inherited from our common ancestor. The anatomical tweaking related to bipedalism and manipulation comes much later.

In addition to the general form of the body, the skull and teeth of great apes have special similarities with these features in humans. While all great apes (especially males) have bigger canine teeth than humans, our molars are very similar to theirs. Monkeys have a more recently evolved molar shape called bilophodonty (two-lobed teeth), which allows them to finely slice the leafy vegetation they consume. (Thus, in their molar morphology, monkeys are more evolved than apes or humans.) Great apes have the largest brains of any primate except humans, even after considering their large body sizes. This is related to the superior cognitive abilities of great apes, exceeded only by our own.

In humans, we find nearly all the attributes that distinguish great apes from monkeys, the exceptions being limb proportions, trunk length, and finger/toe length. Our upright backbones, broad torsos, mobile shoulders and wrists, extendable elbows, large brains, and slow growth are remarkably similar to those of apes, especially great apes, and most especially African apes. Even our manipulative hands and stable feet, while in some ways unique, find their precursors among the African apes. It is unimaginable that all these shared attributes arose independently. Combined, they offer undeniable evidence that we inherited all these characteristics, so critical to human biology and behavior, from the ancestor we share with living great apes. A close look at great ape and human anatomy shows us that we are basically great apes, with skeletons retooled for bipedalism, smaller jaws and teeth reflecting changes in diet, and enlarged brains related to our incredible adaptability.

The best known of the archaic fossil apes is *Ekembo*, found in seventeen-million- to twenty-million-year-old sites in Kenya. *Ekembo*, which John depicts in the evolutionary tree and in a portrait (opposite), was an ape but looked more like a monkey. It has arms and legs of equal length, a monkey-like torso and backbone, and a baboon-size brain. But *Ekembo* did not have a tail, and this, among other, more subtle features, tells us that it was an ape and not a monkey, all of which have tails. It is a classic intermediate form, as *Archaeopteryx* is between birds and dinosaurs. No one knows "why the ape lost its tail." It may have been a random event, but it probably did force apes to enhance the use of their hands for balance in the trees.

The other fossil ape faces in John's book illustrate the amazing diversity that lived on what I like to call "the real planet of the apes." Imagine a continuous forest from Spain to China, extending in the north to Germany and in the south to the equator, populated over the course of about fifteen million years by more than one hundred species of extinct apes ranging from the size of a house cat to that of a polar bear! Some ate leaves, others fruit, and still others seeds and nuts. Some walked on the tops of branches, others swung below them, and still others walked primarily on the ground. This was the apex of ape-dom, with a greater diversity, in number of species and types of adaptations, than before or since. You can see the transformation from the more monkey-like *Ekembo* to *Sivapithecus*, from South Asia, looking a lot

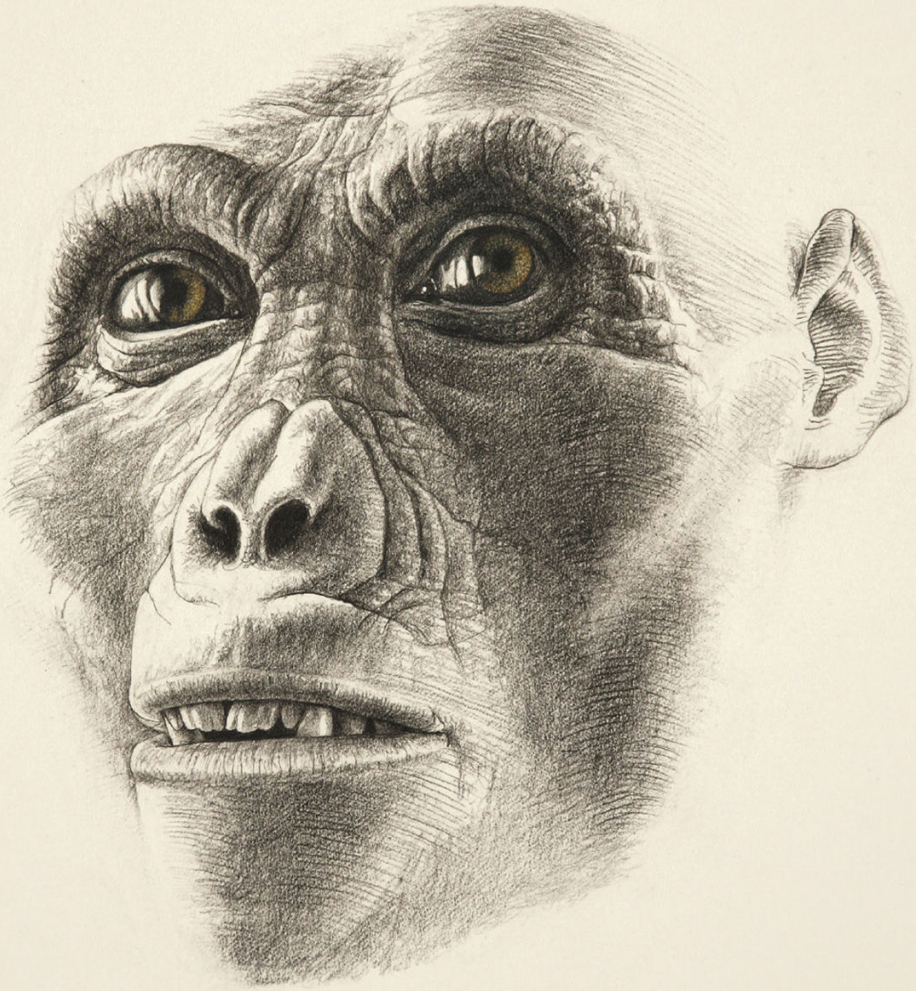
Ekembo, an archaic ape, with family tree, including skulls of (left to right) an old world monkey, ***Ekembo,*** a gibbon, ***Sivapithecus, Pongo*** (orangutan), ***Rudapithecus, Gorilla, Homo sapiens,*** and ***Pan*** (chimpanzee). Acrylic with red and black chalk on board.

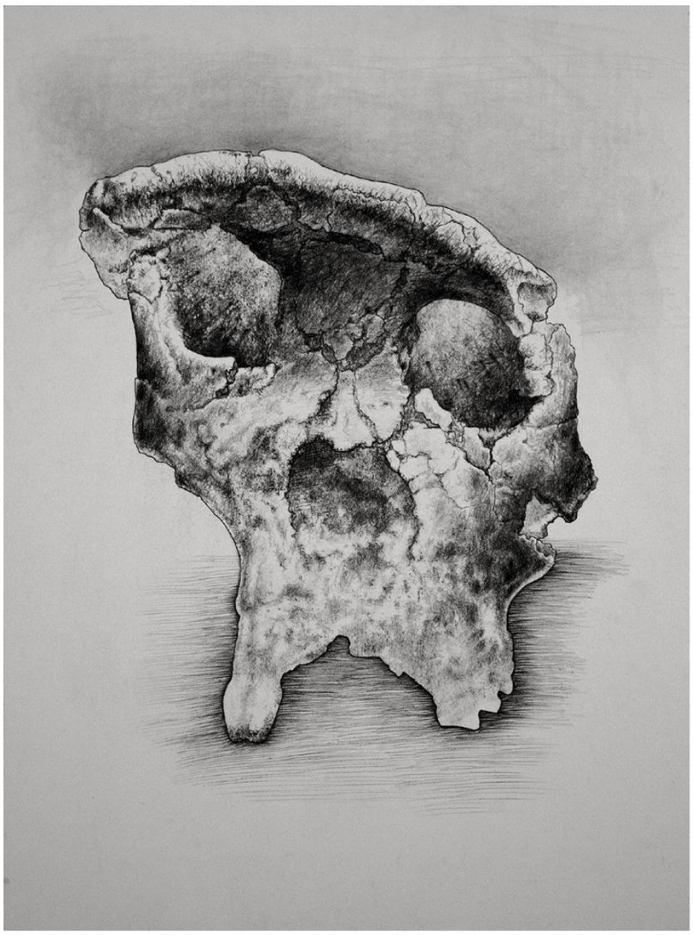
Rudapithecus hungaricus
female. Pen and ink on paper.

Opposite:
Oreopithecus bambolii.
Graphite on board.

like an orangutan (page 17), and *Ouranopithecus*, the fossil great ape from Greece that closely resembles a gorilla (page 26). The weird-looking head of *Oreopithecus* (page 25), with its tiny braincase and big jaws, shows what can happen when an ape evolves in isolation on an island, in this case converging with the anatomy of South American sloths!

Rudapithecus, positioned in John's family tree between the orangutan and the gorilla and also represented in a portrait (above) and a skull drawing, was one of the last great apes to survive in Europe. Finding that skull at a site in Hungary was one of the most thrilling moments of my career. Placing *Rudapithecus* between orangs and African apes means that it shares a common ancestor with African apes that orangs do not. In other words, *Rudapithecus* is part of the African ape lineage, having evolved after the orangutan branched off. *Rudapithecus* and related apes from Europe are African apes in the evolutionary sense, and they are older than any African ape fossil from Africa, which means that the common ancestor of African apes and humans evolved in Europe (modern humans first appear in Africa about 300,000 years ago).





While the oldest known relatives of African apes and humans are European, the best known candidates for the earliest hominins (humans and our fossil relatives more closely related to us than to the chimpanzee) come from Africa. The oldest of these is *Sahelanthropus*, from the six-million- to seven-million-year-old site of Toros-Menalla in Chad. John's images are compelling. The fossil looks to most like a squashed and cracked skull, but to the paleoanthropologist it is fabulously complete and informative (above). The face of *Sahelanthropus* highlights John's skills as an artist. More than any other reconstruction I have seen, this one exquisitely captures the anatomy of this hominin (page 52).

Sahelanthropus tchadensis skull. Graphite on board.

Opposite:
Ouranopithecus macedoniensis. Pen and ink on paper.

Not everyone agrees that *Sahelanthropus* is a hominin, and, looking at John's portrait, you can see why. I think *Sahelanthropus* is a hominin. It has smaller canines than male chimpanzees of the same size. Hominin males have small canines that are barely distinguishable from those of hominin females, while canines in great ape males are distinctly larger than those of females. There are many ideas about why this is so. The one that makes the most sense to me is that large canines in apes are like big antlers in deer or big horns in antelopes. They function in competition, enabling individuals to psych out adversaries without having to resort to blood-letting (though this does occasionally occur). Reduction in male canine size among hominins may be related to increased cooperation among males (no need to be intimidating if you want to work together) and most likely came about as females evolved the behavior of preferring to mate with males with smaller canines that were more likely to be cooperative rather than aggressive.

Sahelanthropus has a foramen magnum that faces downward and is positioned on the base of the skull near its center of balance. What does that mean, exactly? The foramen magnum (literally, "big hole") is the aperture through which the base of the brain leaves the braincase to enter the neck and become the spinal cord. In apes and most other mammals, the neck connects to the head from behind so that the head essentially hangs out in front of the backbone, and the foramen magnum is at the rear of the skull. In *Sahelanthropus*, the more central and downward-facing foramen magnum means that the head is balanced on top of a vertical neck, as in humans. This is widely viewed as a sign that, like humans, *Sahelanthropus* was a biped. So the evidence for bipedalism in *Sahelanthropus* is convincing but somewhat indirect. This is not the case with the next candidate in time for early hominin, *Orrorin*.

The *Orrorin* sample, from the six-million-year-old site of Lukeino in Kenya, is made up of more fragmentary cranial remains than *Sahelanthropus*, but a femur (thigh bone) is known. The femur bears the hallmarks of a biped and closely resembles that of *Australopithecus*, as illustrated in John's artwork (page 53). *Orrorin* shares a smaller canine with *Sahelanthropus* (and later humans), but there are other differences from *Sahelanthropus* that convince most researchers that *Orrorin* is a distinct early hominin. It is not clear if either one is close to the actual ancestry of humans or if they are side branches that represent early "experiments" in human bipedalism, but they are hominins.

I round out this introduction with *Ardipithecus*. There are two species of *Ardipithecus,* but the best known is *Ardipithecus ramidus*, the one illustrated by John (pages 54 and 55). *Ardipithecus ramidus* is a 4.4-million-year-old hominin best known from the site of Aramis in Ethiopia. We have many fossils of *Ardipithecus,* including a partial skeleton. It is a hominin, a biped, and probably an ancestor of *Australopithecus*, whom you will meet in the next chapter.

The teeth of *Ardipithecus* closely resemble those of *Australopithecus*. The back teeth are generally smaller than in *Australopithecus,* while the front teeth, especially the canines, are larger than in most *Australopithecus*, but they are reduced compared with those of living and fossil great apes. The limb proportions are intermedi-

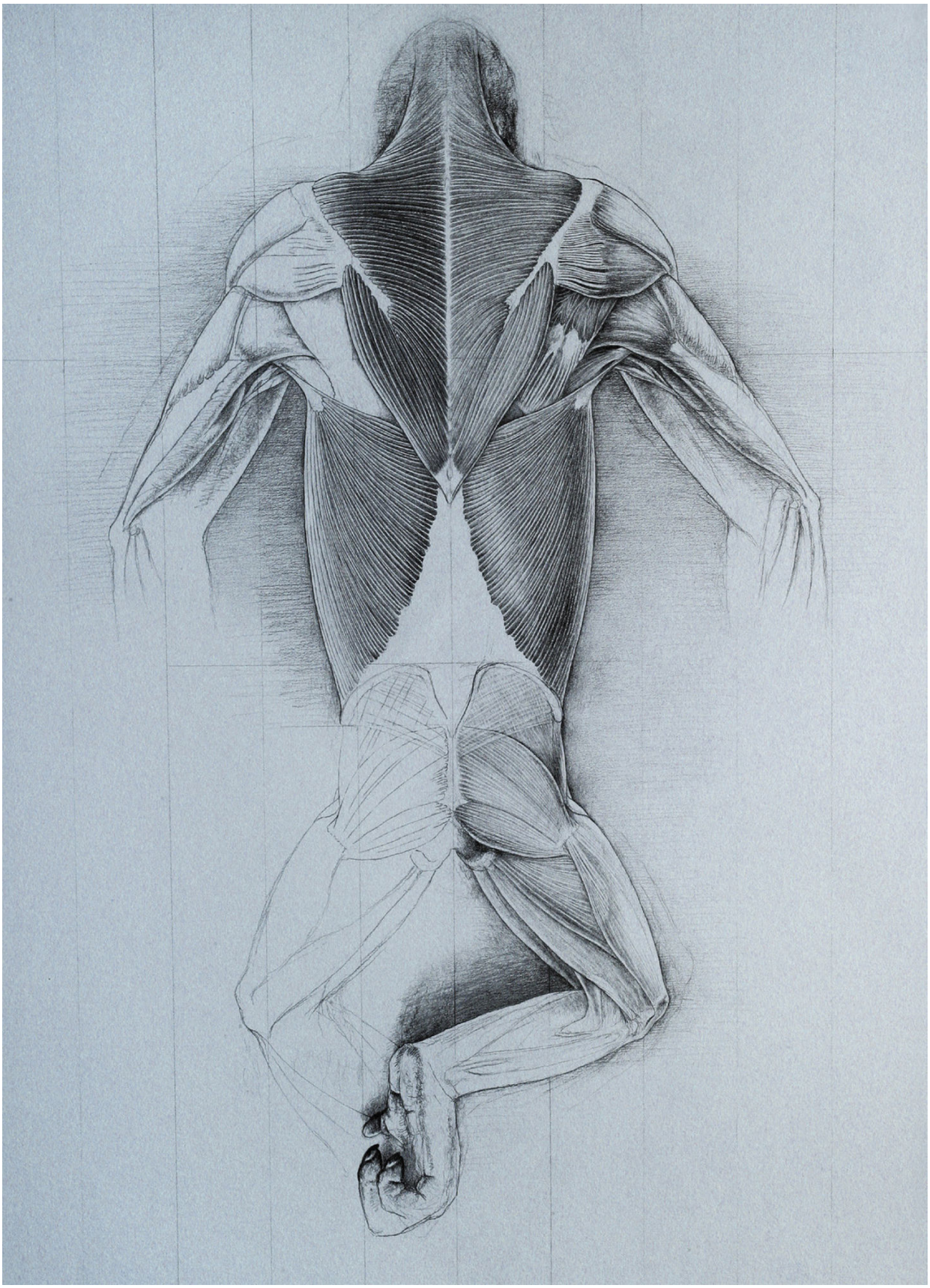
ate between the long arms and short legs of apes and the short arms and long legs of modern humans. In this, it resembles *Australopithecus,* although not as far along in the trend toward shortened arms and lengthened legs. The pelvis also resembles that of *Australopithecus*, with a broad, short ilium (the blade-like portion of the hip bone). This is critical for human bipedalism, as is described in the next chapter. Like the limb proportions, the hip bone is a bit less humanlike than in *Australopithecus*, but it looks nothing like the elongated hip bones of living great apes and clearly identifies *Ardipithecus* as a biped. Many other attributes of *Ardipithecus* are also shared with *Australopithecus,* but there is a significant difference: the big toe, or hallux.

When I was a student, I learned that all hominins must have adducted, not abducted, halluces. An adducted hallux is aligned with the other toes, facing forward and incapable of grasping or of much side-to-side movement. This makes a lot of sense, since the hallux in humans is the last part of the body to leave the ground in walking. It needs to be large and relatively immobile to withstand the stresses transmitted by body mass and acceleration, and to allow the muscles of the lower limb to efficiently propel the body forward. You cannot be a human biped without an adducted hallux. Wrong! Here is another example of a beautiful theory foiled by an inconvenient fact. *Ardipithecus* has an abducted big toe, as great apes do, capable of grasping and pointed toward the opposite foot (rather than facing forward and parallel to the other toes). Like living great apes, *Ardipithecus* could grab branches with its feet, but its other toes are shorter than those of great apes, so that its arboreal capability was probably less than what we observe in living great apes. We cannot say exactly how *Ardipithecus* used its hallux, because the entire foot is not known, but it does seem that *Ardipithecus* managed to be a biped without an adducted big toe. It is likely that it could grasp branches with its feet and was a better climber than *Australopithecus*, but, given the morphology of the hip bone, the mechanisms were there to allow it to be an efficient biped.

Humans retain numerous attributes related to our special relationship to African apes. We must have gone through suspensory and knuckle-walking phases before becoming bipedal, accounting for our tremendous similarities with our ape cousins. The ape in us, both inside and out, is beautifully illustrated in this book. The combination of aesthetically moving yet technically brilliant images is Leonardesque. They demonstrate as much as anything I have seen that we owe the essence of our biology and behavior to our shared ancestry with the great apes. This is one of the great messages of paleoanthropology. I hope they will inspire readers to recognize the undeniable fact of human evolution and the natural, biological transformation from ape to us.

Left:
Muscles of facial expression in a male *Pongo pygmaeus* (Bornean Orangutan). Graphite on board.

Below:
Pongo pygmaeus male. Graphite with pen and ink.

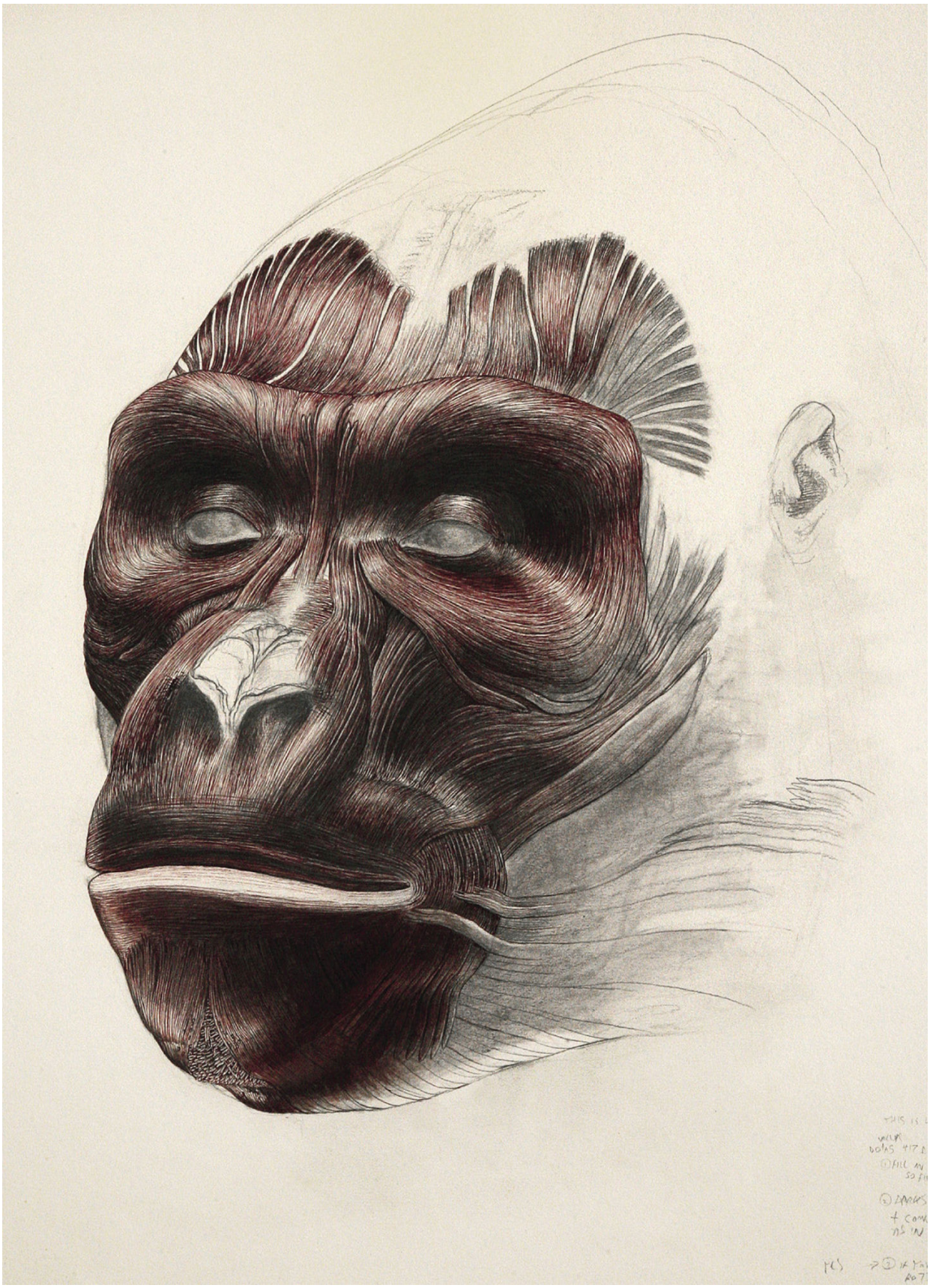


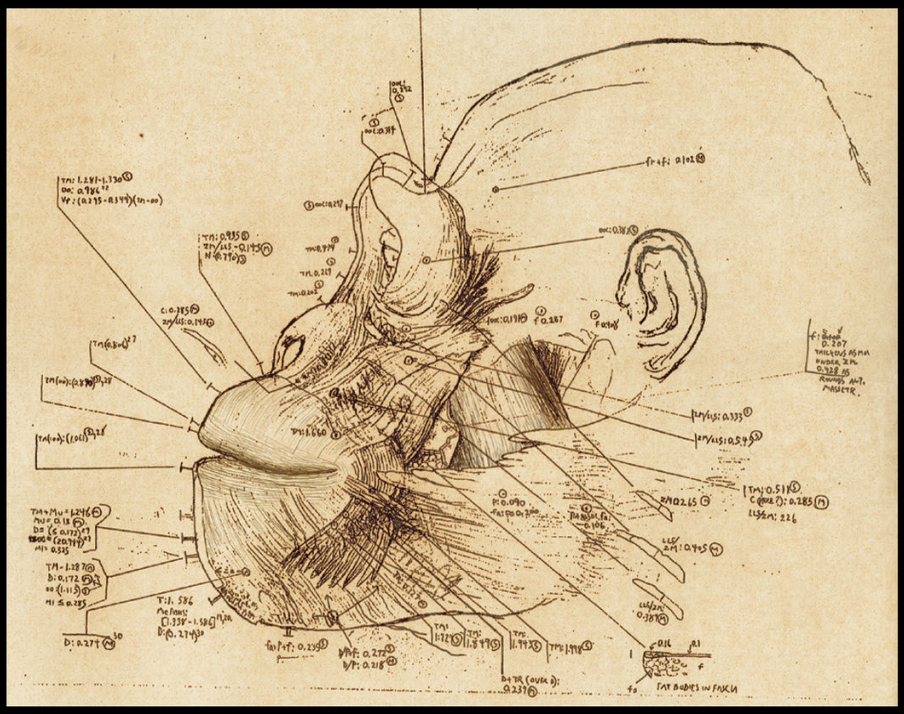
Muscles of the forearm and hand in a female *Pongo pygmaeus* (Bornean Orangutan). Graphite on acrylic-washed board.

Opposite:
Muscles of the back in a female *Pongo pygmaeus*. Graphite on paper.

Skull of a male ***Gorilla gorilla.*** Pen and ink on paper.

Opposite:
Gorilla gorilla muscles of facial expression. Graphite with pen and ink on board.

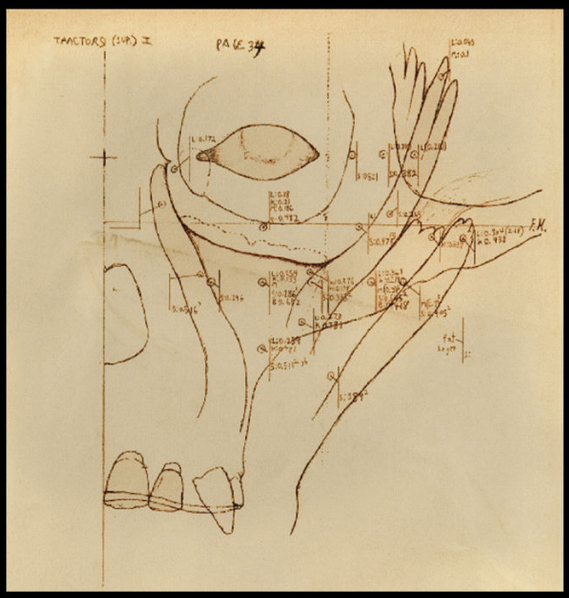




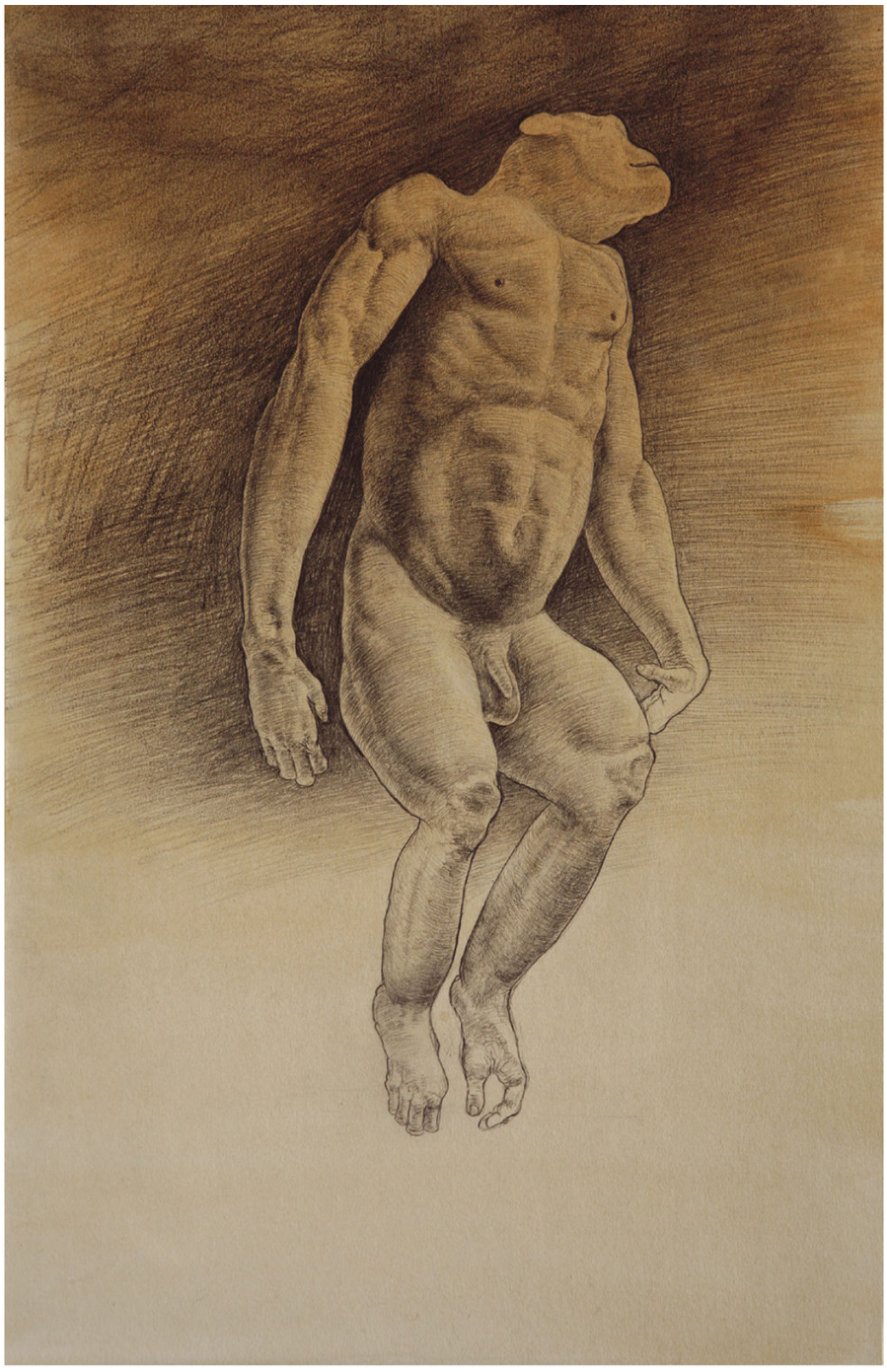
Facial muscles in *Gorilla gorilla*. Digitally altered graphite drawing with pen and ink.

Right:
Generalized plan of the facial muscles in African apes. Digitally altered graphite drawing with pen and ink on board.

Opposite:
Pan paniscus (bonobo) pregnant female. Pen and ink on board.

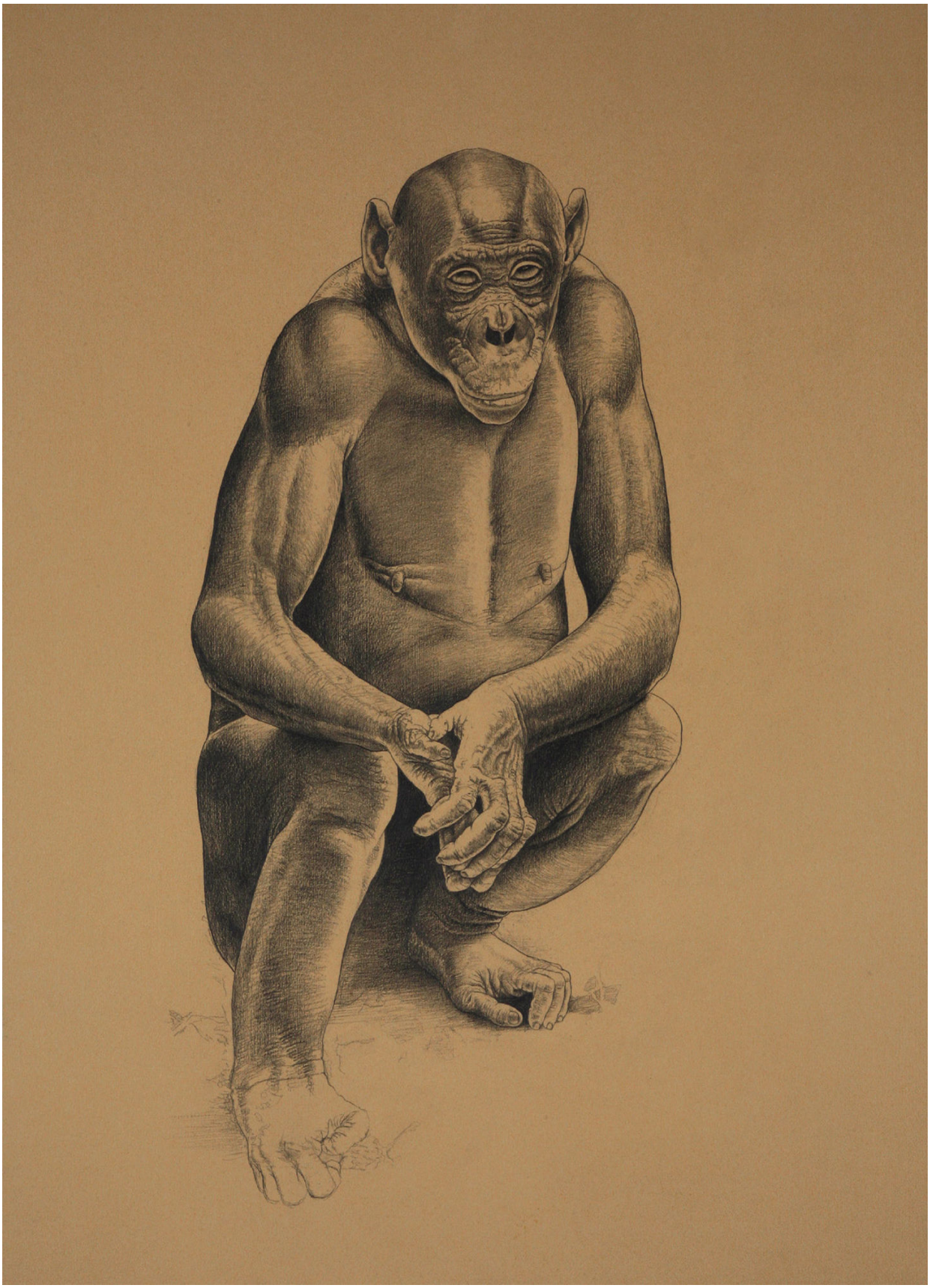


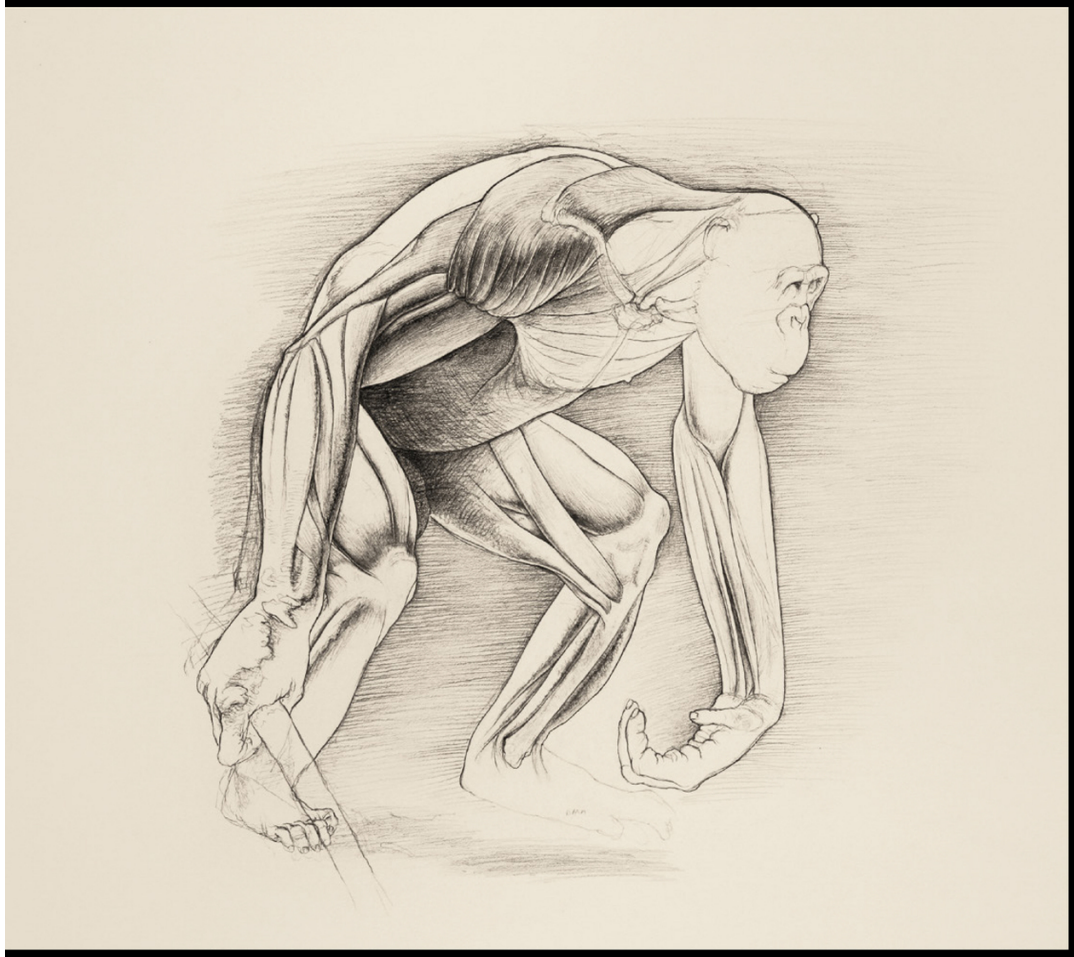
pregnant ♀ Pan paniscus



Pan paniscus (bonobo) male. Graphite on acrylic-washed board.

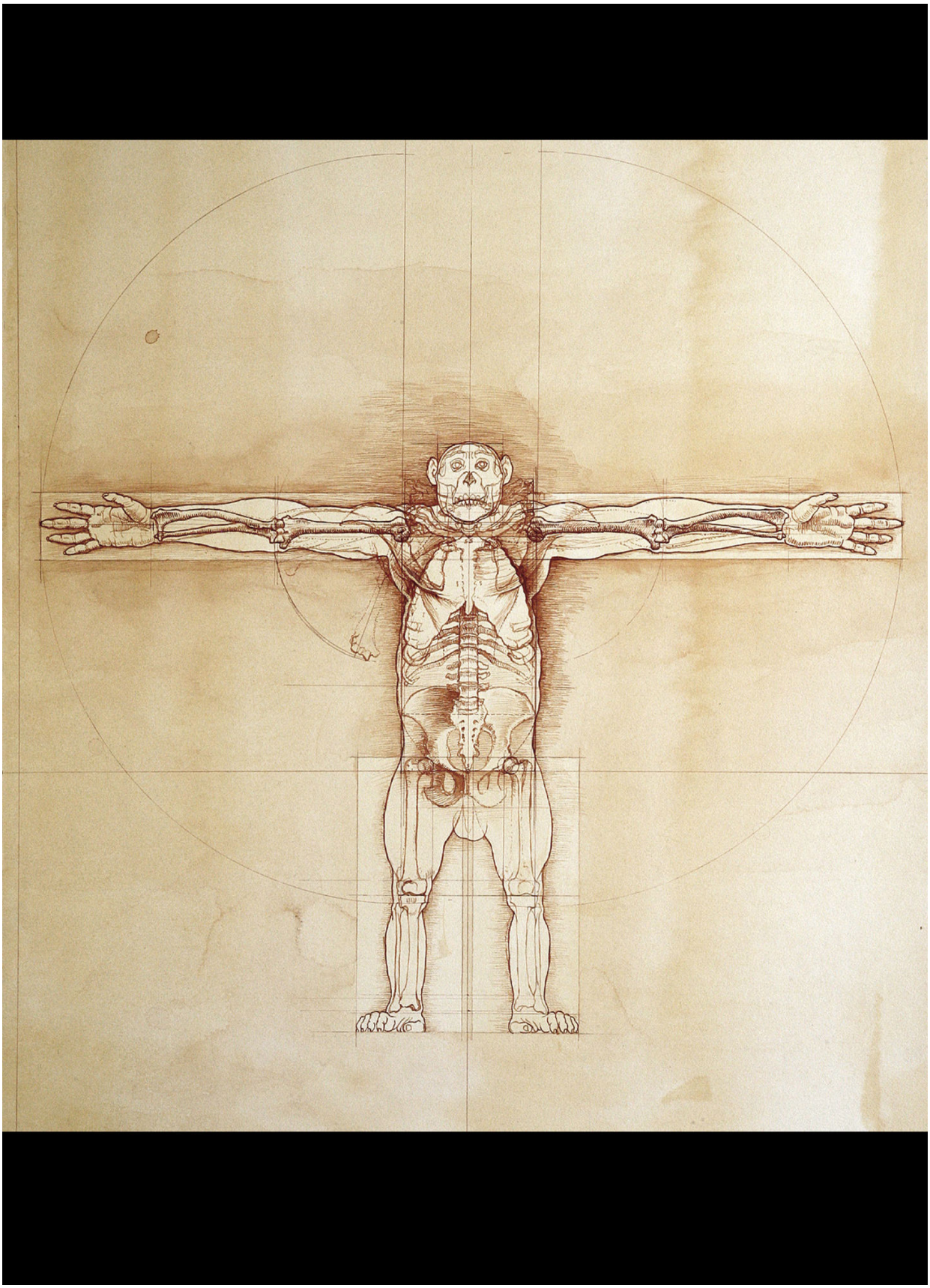
Opposite:
Pan paniscus female. Graphite on colored paper.

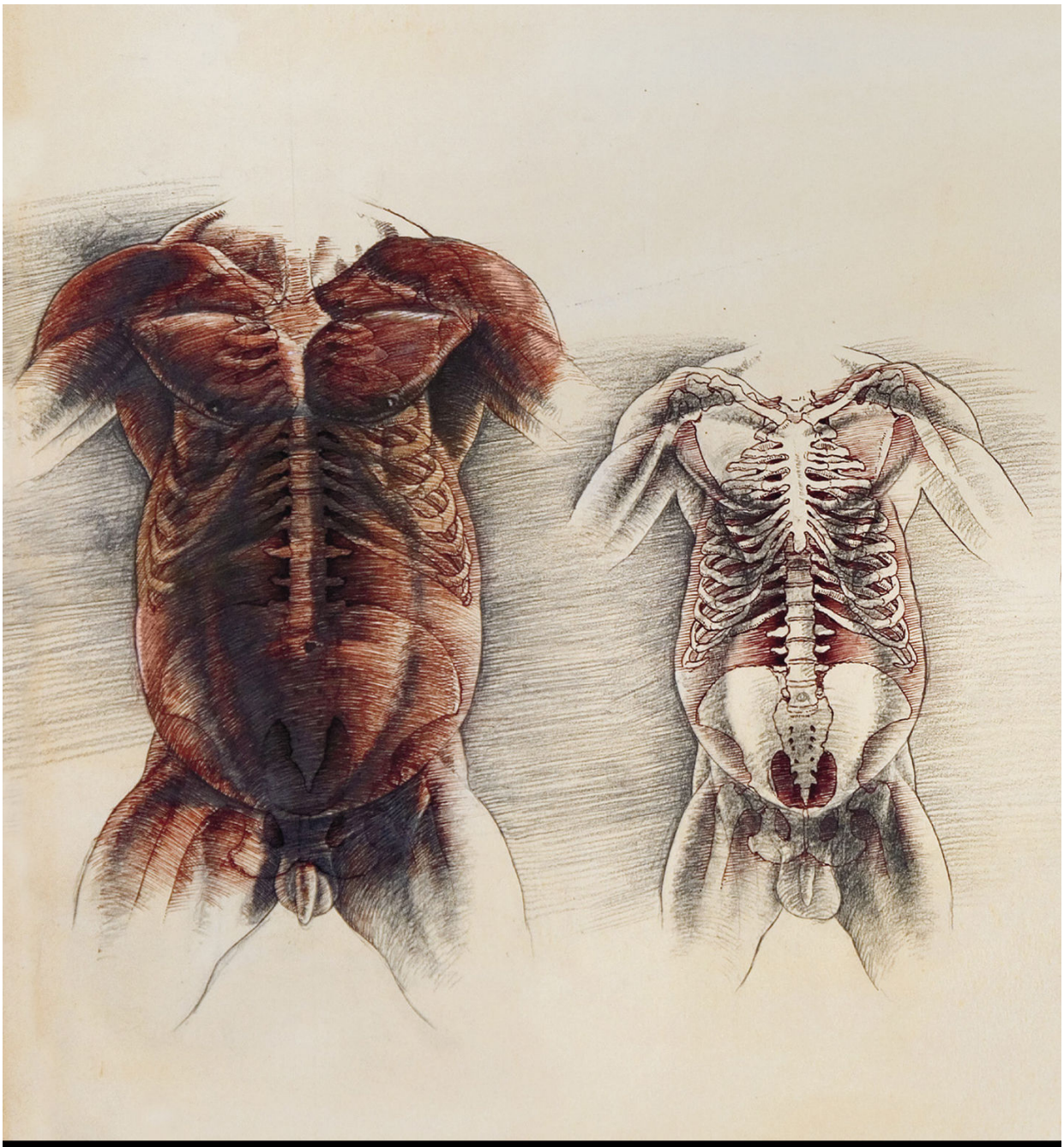




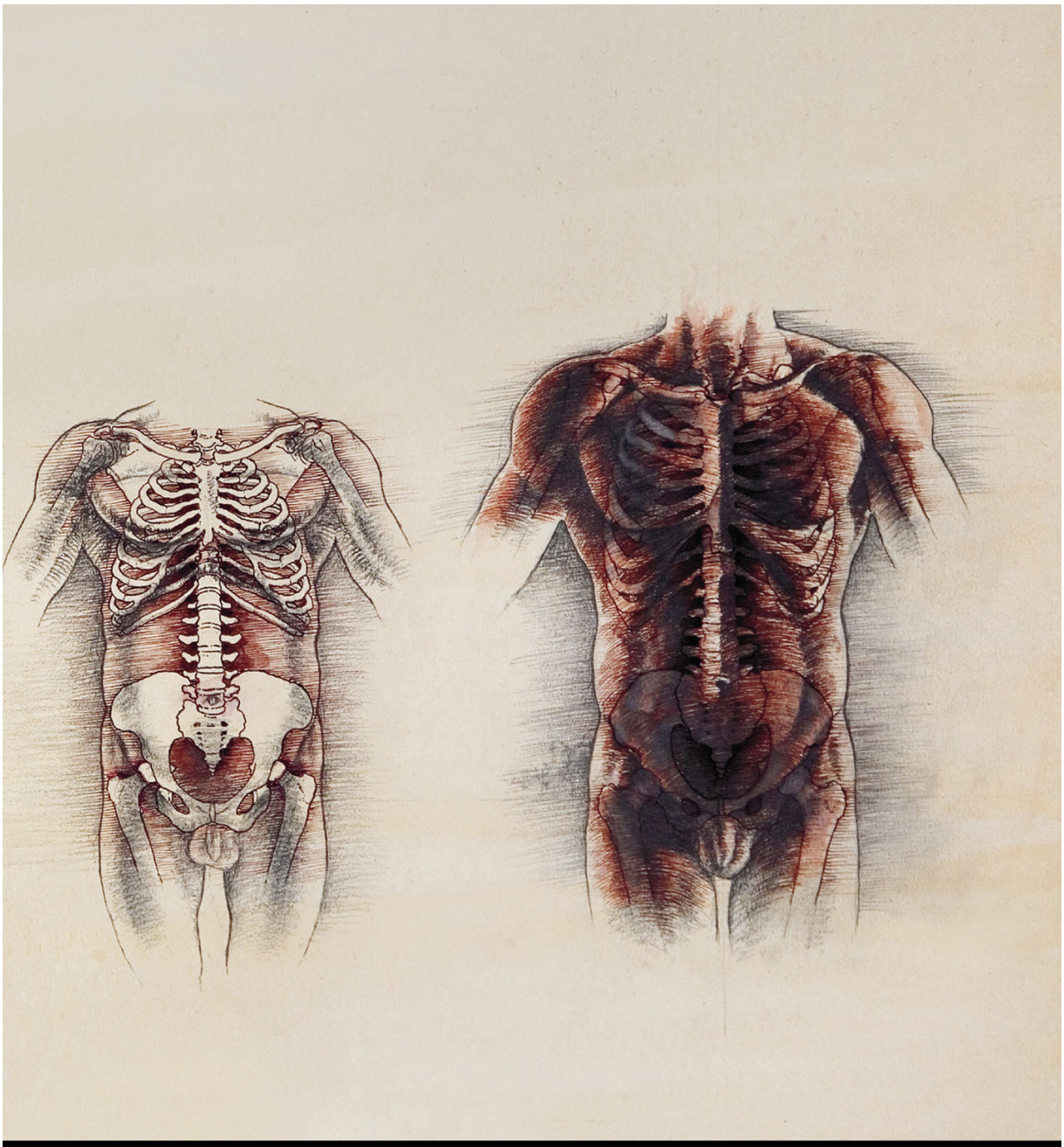
Musculature of a *Pan paniscus* (bonobo) male. Graphite on board.

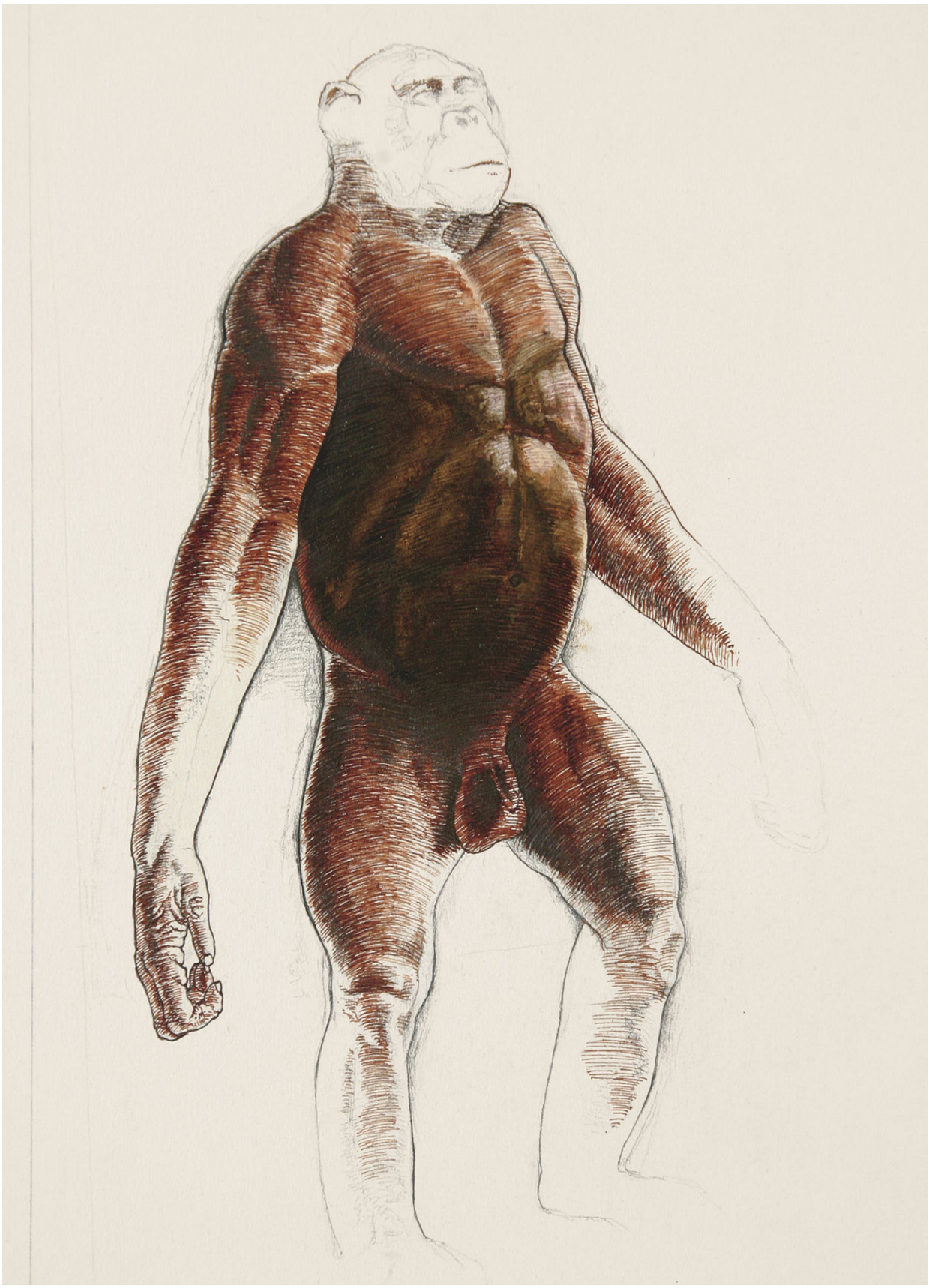
Opposite:
"Vitruvian Chimp." Body proportions in *Pan troglodytes* (chimpanzee) male. Pen and ink on acrylic-washed board.





Studies of the plan of the trunk in African apes and hominins. From left to right, ***Gorilla gorilla, Pan troglodytes*** (chimpanzee), ***Australopithecus africanus*** (reconstructed), and ***Homo sapiens***. Graphite with pen and ink on board.





Pan paniscus (bonobo) foot. Red chalk on paper.

Opposite:
Pan troglodytes (chimpanzee) male. Pen and ink with graphite on board.

Muscles of the foot in ***Pan paniscus*** (bonobo). Pen and ink, graphite, and acrylic on board.

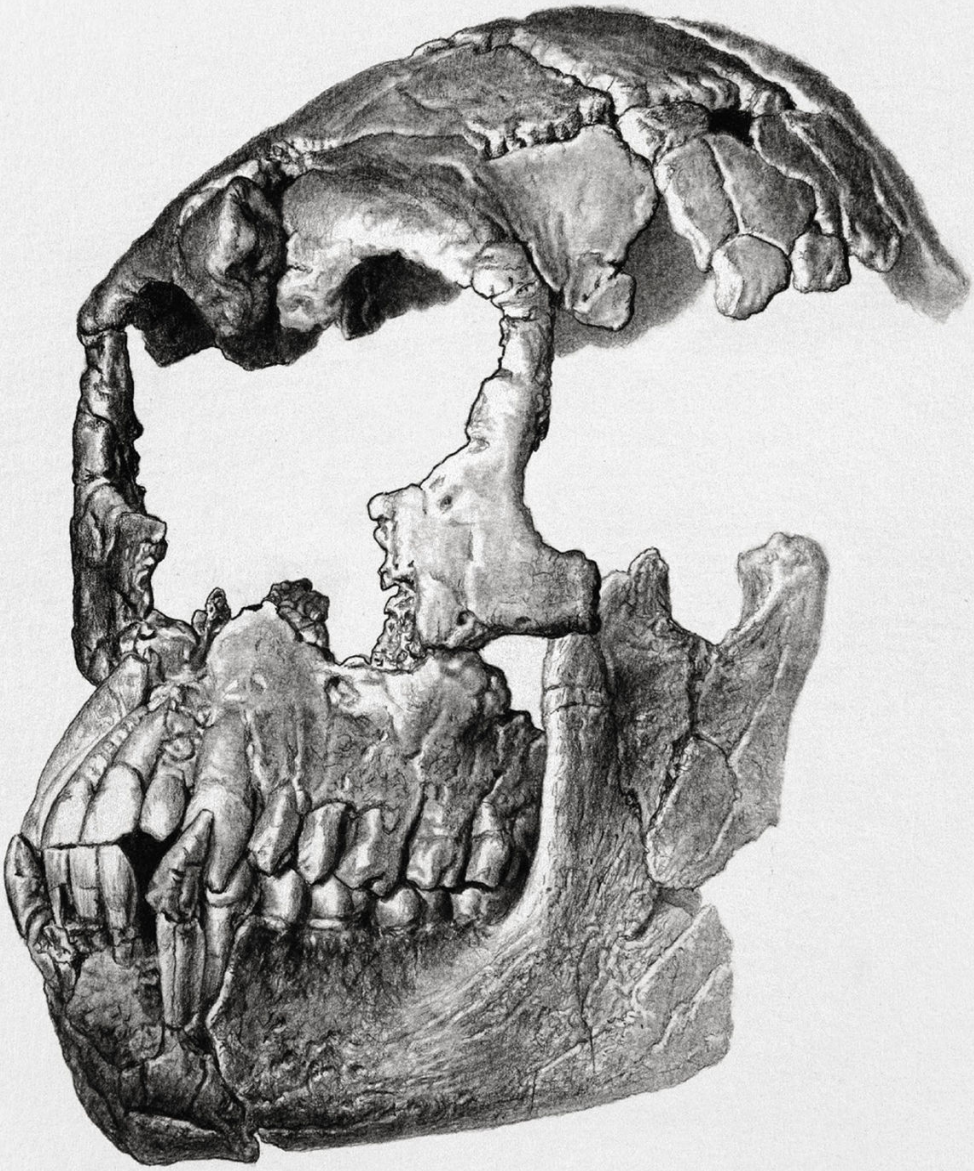
Opposite:
Pan paniscus feet (male). Pen and ink with graphite on board.

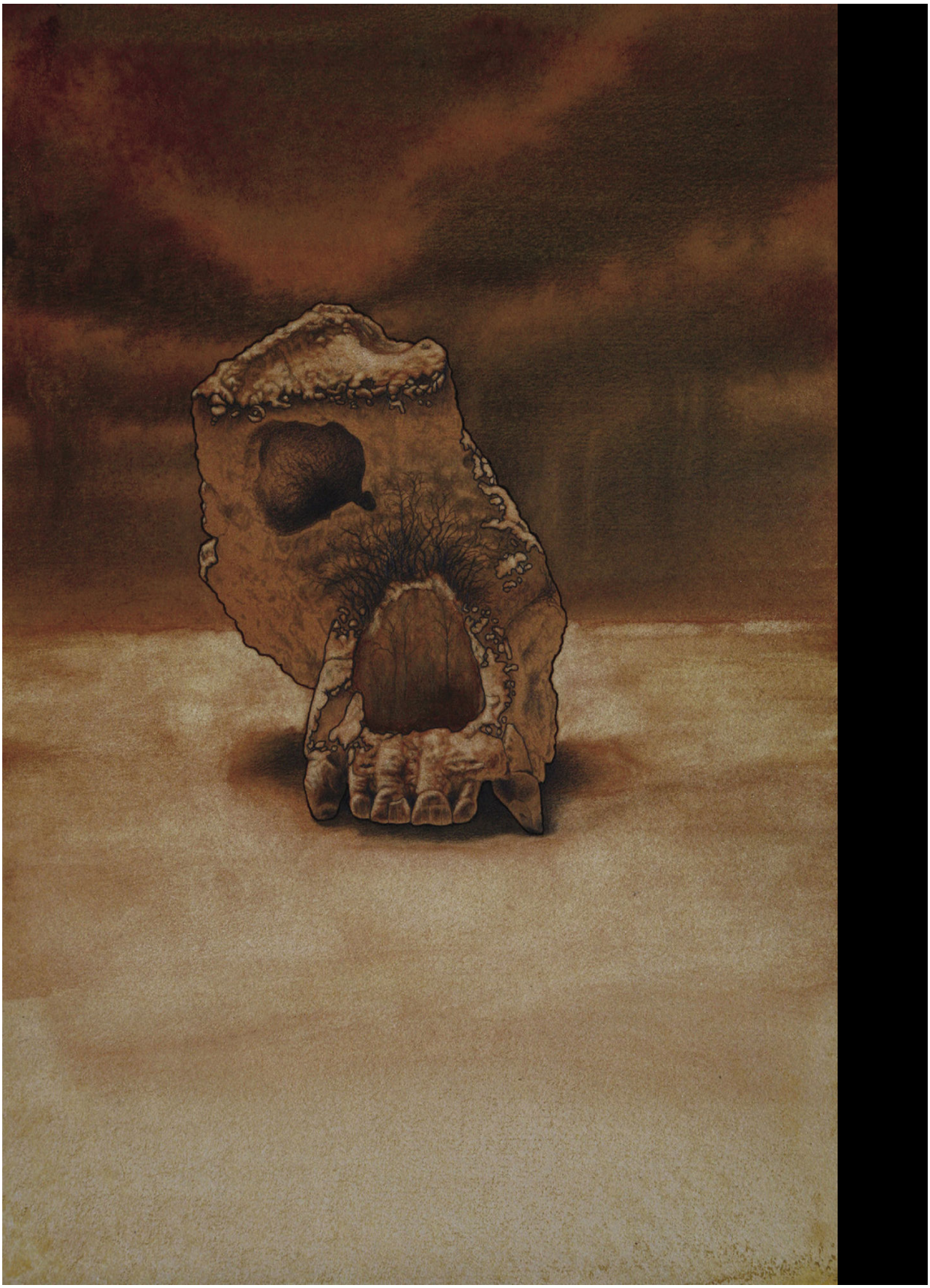
Below:
Muscles of the great toe in *Pan troglodytes* (chimpanzee). Graphite with pen and ink on acrylic-washed board.

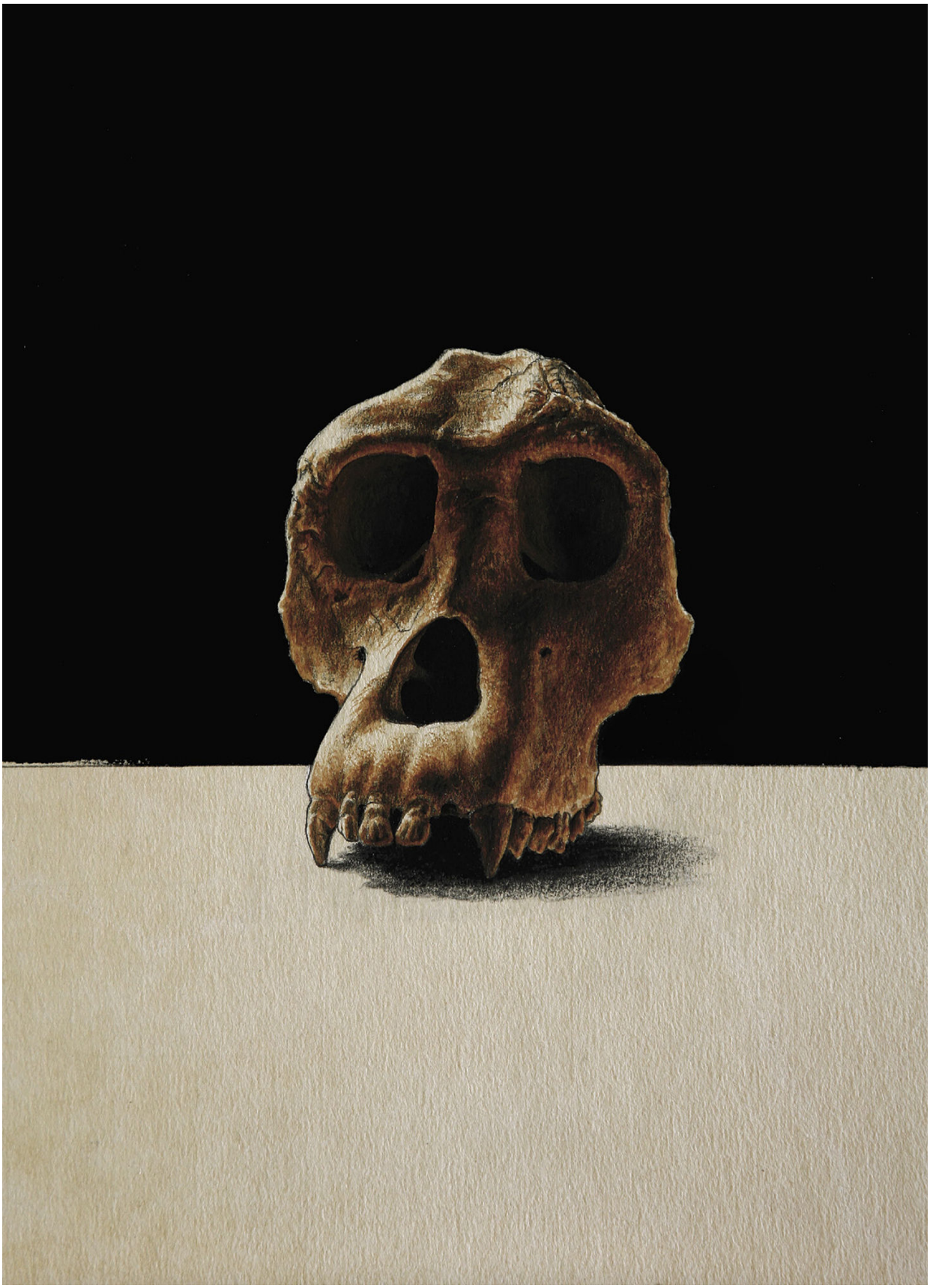
Opposite:
Rudapithecus hungaricus female skull. Graphite on paper.

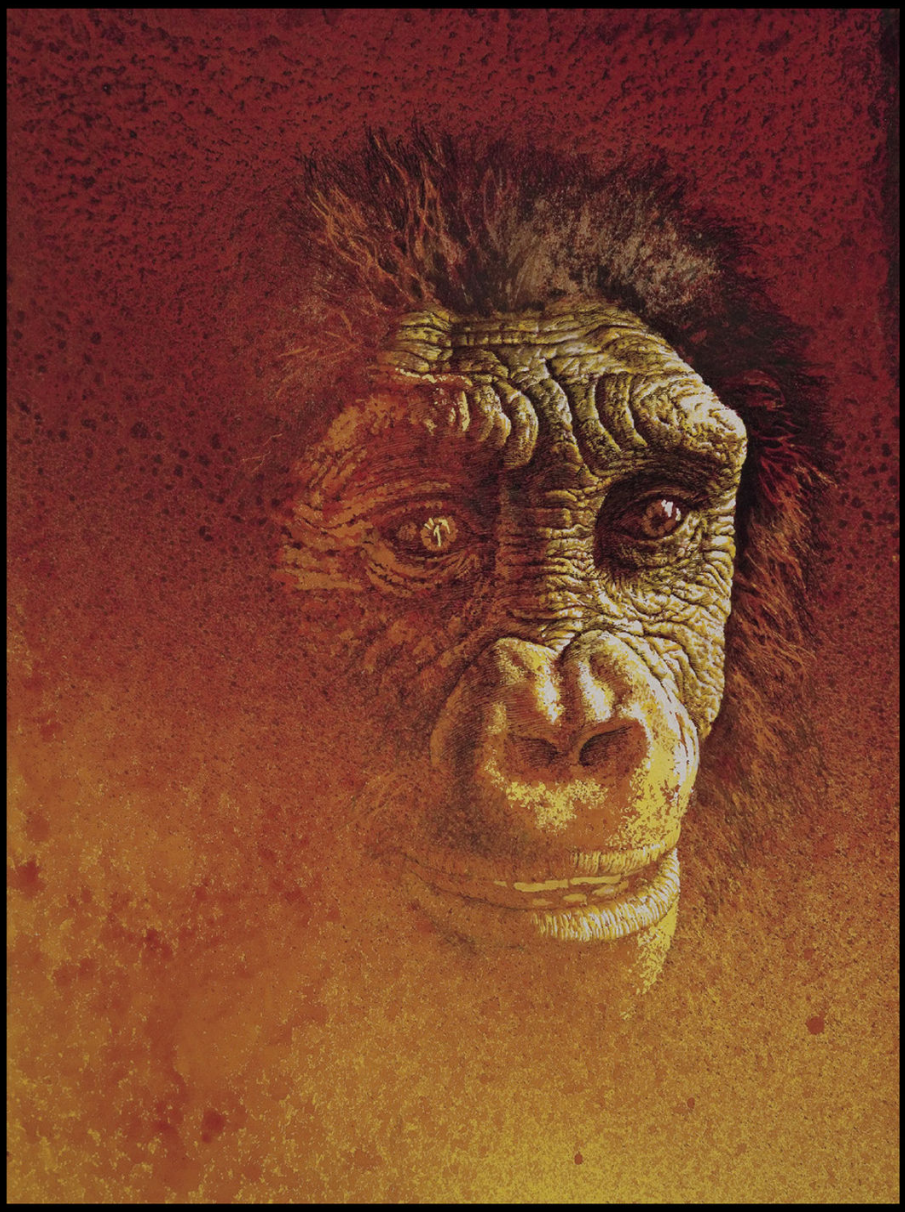
Overleaf left:
Ouranopithecus macedoniensis skull. Graphite, ink, and acrylic.

Overleaf right:
Hispanopithecus laietanus skull. Graphite, ink, and acrylic.









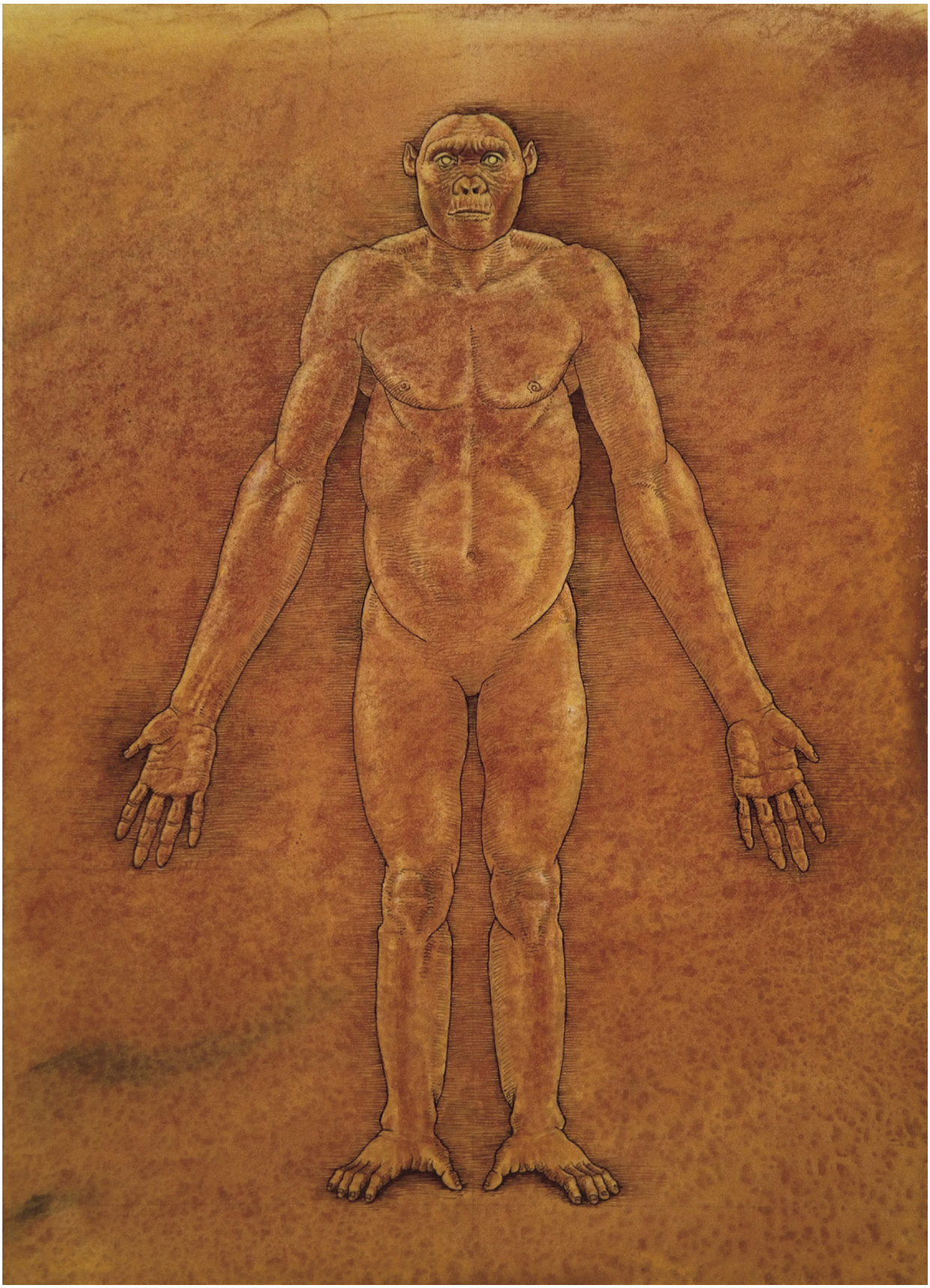
Above:
Sahelanthropus tchadensis. Graphite, ink, and acrylic.

Opposite:
Femur of ***Orrorin tugenensis*** (in red), with femora of ***Australopithecus afarensis, Paranthropus robustus,*** and early ***Homo*** (species undetermined), resting on drawing of walking hominins. Digital work with pen and ink. Based on a photograph by Brian Richmond.

Left:
Ardipithecus ramidus reconstructed hand. Graphite on paper.

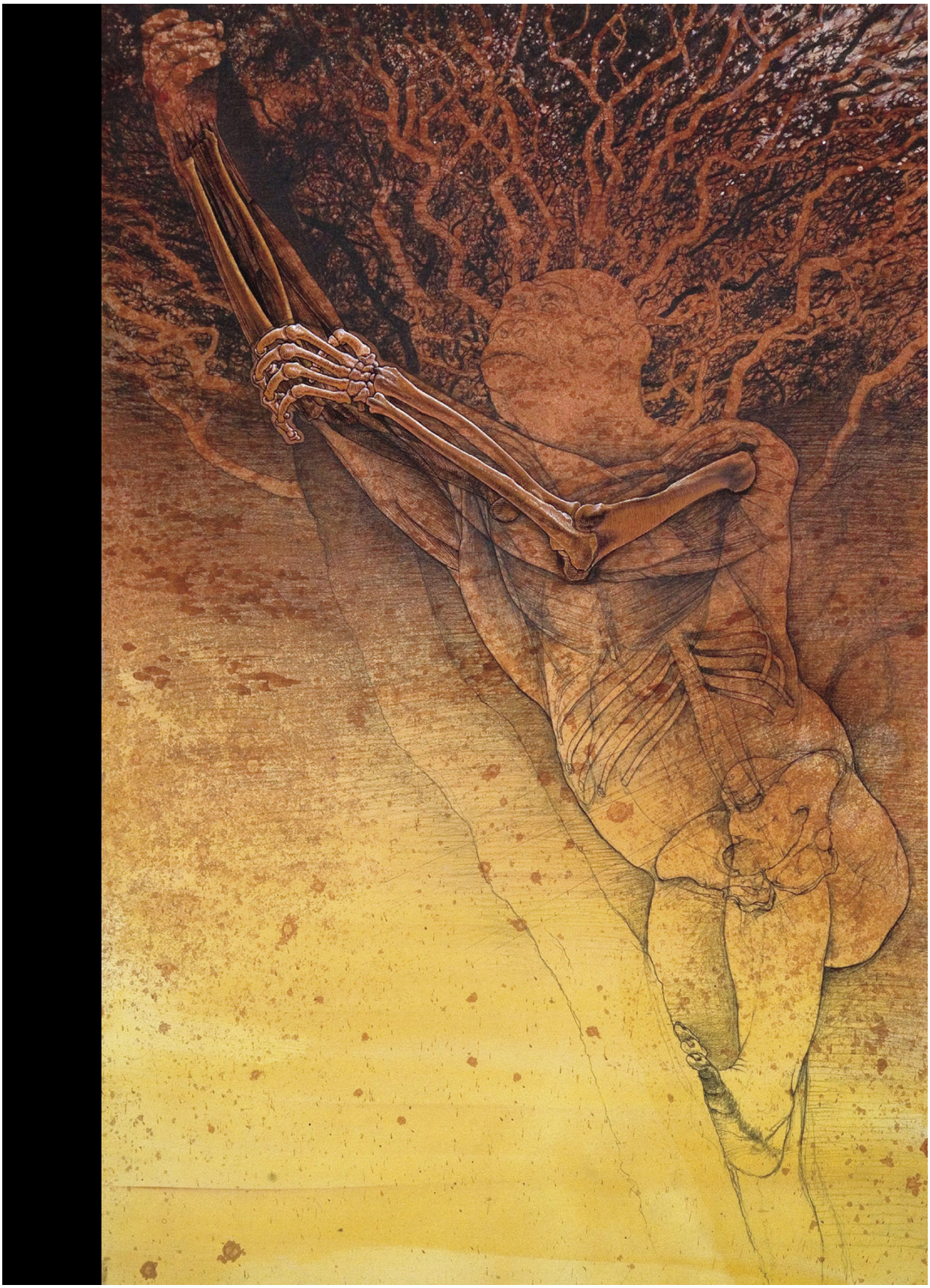
Above:
Ardipithecus ramidus reconstructed composite skull. Pen and ink with graphite on acrylic-washed board.

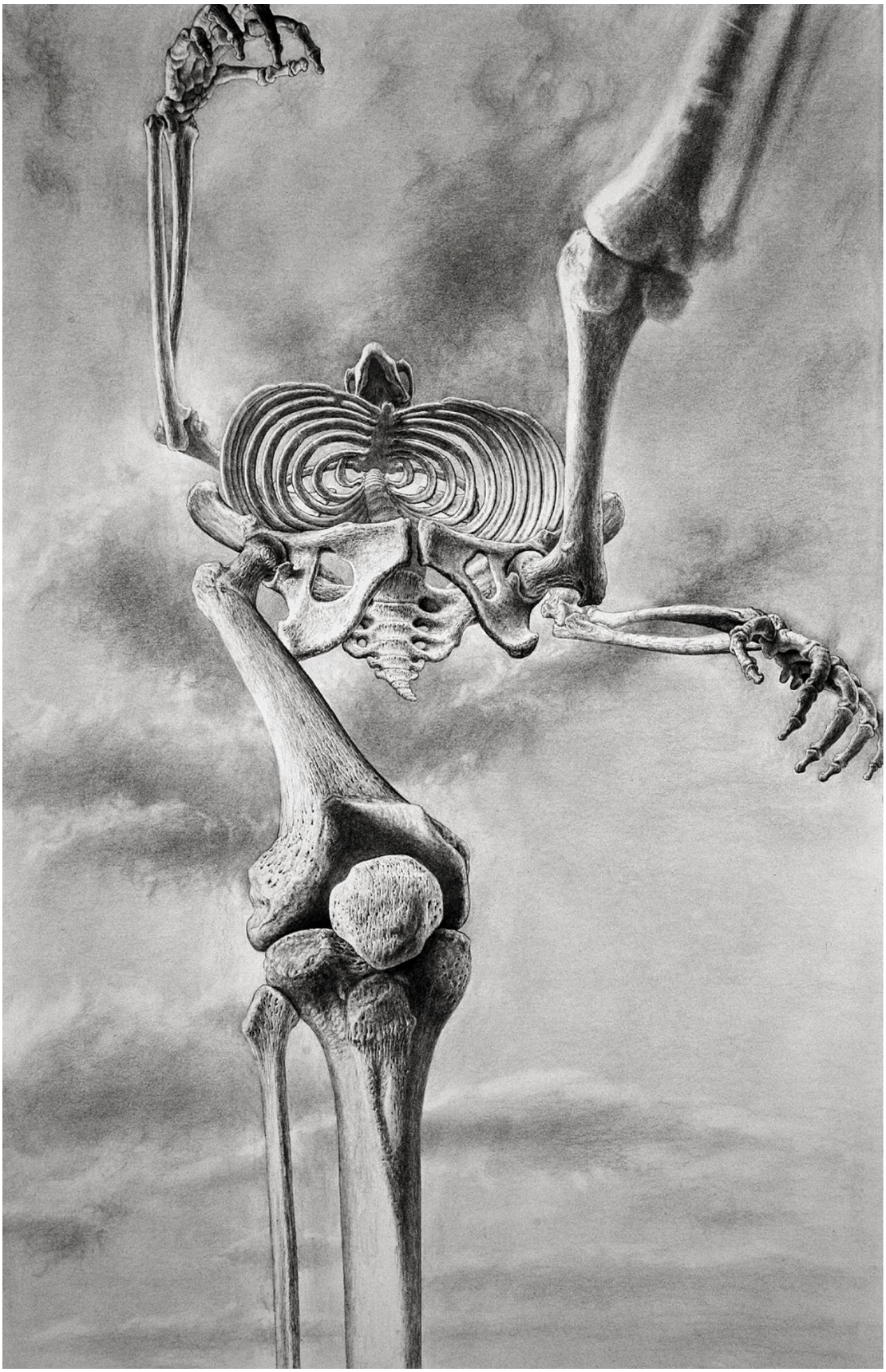
Opposite:
Ardipithecus ramidus reconstructed. Pen and ink with red chalk on board.



Carol Ward

2 AUSTRALOPITHS





Previous page:
"The Climber." *Australopithecus afarensis* male. Graphite with pen and ink on acrylic-washed board.

Opposite:
Australopithecus afarensis female. Reconstructed Lucy skeleton in mid-stride. Graphite on board.

There is nothing quite as awe-inspiring as seeing a new hominin fossil for the first time. As a scientist, I have tremendous fun exploring the anatomical details of a specimen, seeing where the cheekbones are positioned, how the teeth are shaped, or how large the muscle attachments are. But as I do so, I am struck by larger thoughts. The fossil I am holding in my hand is a small part of what was once a living, breathing individual that roamed Africa millions of years ago, unlike any roaming the planet today. I felt this acutely when I was working on the famous Lucy skeleton, part of an adult female *Australopithecus* (pages 58 and 66). What kind of a creature was she? What did her hair look like? Her skin? Her eyes? How did she spend her days? Did she use sticks to fish for termites, or leaves to soak up precious water from a small puddle on a dry day? How did she greet her mate or her children or her group after they had been apart? How did she react when she met a stranger? What did she sound like when she called to her kin? Did she smile when she was happy? Did she laugh? We can never fully know the answers to questions like these, but we can begin to form a picture of individuals like Lucy from the fossil record.

The fossil record is a jigsaw puzzle with most of its pieces missing. We do not, nor will we ever, have all the pieces we need to see the entire image. We will only ever have a few pieces here and there that we must use to infer the whole. Yes, we have thousands of fossils representing our ancestors. Yes, we have most bones in the body represented for several species. We even have partial skeletons. We have bones from males, females, the young, the old, the infirm, the healthy. But even if we had complete skeletons of many individuals of many species, these would not fill in the entire picture of our earliest ancestors. This is my job as a scientist—to re-create a picture from the pieces we are lucky to have. And that is what this book is about. Using the fossils we do have, John is creating a picture of the coming-to-be of the human form.

The story of how we became human really takes off in that time and place where some of our ancestors, after branching off from our more ape-like forebears, became committed to living on the ground at least most of the time, being able to eat pretty much whatever they ran across and moving from place to place on two feet instead of four. The first of our relatives to have adopted this lifestyle were members of a group of species we refer to as "australopiths," which includes the genera *Australopithecus* and *Paranthropus*. Of course, there were earlier hominins, but none that had fully adopted this suite of adaptations. It was an australopith species that was the raw material on which selection acted to produce the genus *Homo*, paving the way for humanity, with our complex social behavior, innovative and pervasive technology, extraordinary communication abilities, exceptional brain, and, ultimately, domination of the planet.

Australopiths were sufficiently successful that they quickly grew into a radiation of at least eight species experimenting and tinkering with these adaptations, one of which almost certainly evolved into our genus, *Homo*. They occupied central, eastern, and southern Africa, and likely even more areas from which we do not have the luxury of a fossil record. They lived in Africa from more than four million years ago until nearly one million years ago—roughly half of the probably six or so million years that our lineage has existed. Certain species likely lived in the same areas at the same time, geologically speaking, and some alongside early *Homo*. Some scientists speculate that these species may even have interacted with one another from time to time.

All australopiths shared adaptations to a committed terrestrial, bipedal lifestyle. This is not to say that they would not have climbed trees—indeed, they must have done so on occasion to find food, to escape predators, and perhaps even to sleep. But their feet, legs, hips, back, neck, and even head were specialized for walking upright on two feet. It is with australopiths that the human foot took shape. Their limbs had changed in proportion to be much like ours, although their arms and hands remained just a bit longer, reflecting their ape ancestry.

Australopiths relinquished an abducted big toe and flexible foot that would have been effective for grasping and climbing trees, in favor of a stiff, propulsive foot with an adducted big toe aligned with the other digits. This humanlike foot structure provided australopiths with a spring in their step and made them expert at walking on the ground (pages 61 and 69). The downside of this structure is that humanlike feet would have severely compromised their agility in the trees, especially problematic for females carrying infants that themselves did not have the grasping feet of most primates that enables them to hold on to their mother's fur. This change alone illustrates how important walking on the ground would have been to their survival and reproductive success, even at the expense of some climbing ability.

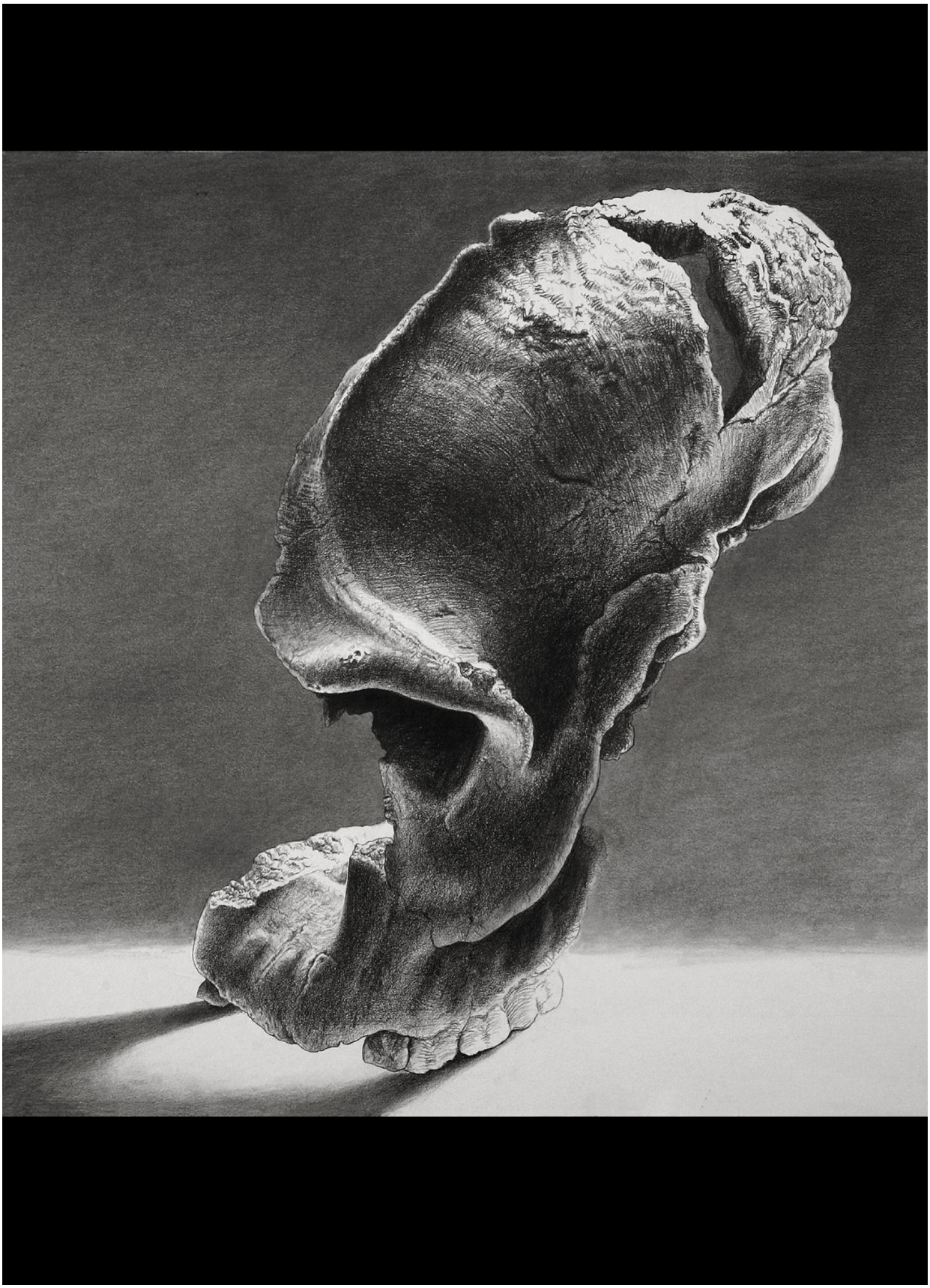
As part of this specialization for walking on two feet, australopiths developed the carrying angle ("knock-knees") that positions the body over one foot at a time while walking. It is also with australopiths that we see the wide pelvis that better positions the muscles that allow the body to balance on one leg at a time during walking

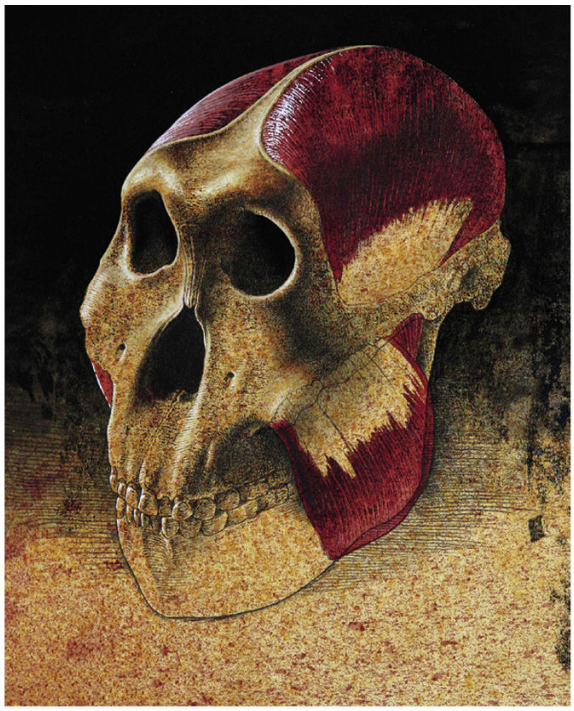
Australopithecus afarensis reconstructed foot anatomy. Graphite, ink, and acrylic on board.

and running. These features were inherited by *Homo*. It is with australopiths that a curve developed in the lower back to help maintain upright posture (the same spinal curvature in *Homo* leads to myriad problems when combined with a modern sedentary lifestyle). The commitment to using the lower limbs for walking also enabled australopith arms and hands to specialize for holding, carrying, and manipulating objects—perhaps not quite as well as ours, but close.

Australopiths would all probably have made and used simple tools of wood or other perishable materials—after all, chimpanzees, bonobos, and orangutans do so today. About 3.5 million years ago, some began making and using tools made of stone. Australopiths were smart. Their brains were proportionally somewhat larger than the brains of apes, with at least some humanlike organization, although they were not nearly as large or complex as ours today. Males were much larger in body size than females, telling us that they would have had to compete for mating rights rather than being monogamous. They did not have the large, projecting canine teeth of apes, though, so they would have fought using size and strength alone, or possibly even with sticks and stones. They almost certainly lived in social groups.

Australopiths were likely omnivores, living on a diet that varied widely from place to place and throughout the year, eating fruits and probably some meat where they could get it, along with nuts, grass seeds, and tubers. Their strong jaws and large teeth would have enabled them to make use of foods that apes cannot. Apes are specialized for eating fruit. Fruit grows on trees, trees grow in forests, and forests had been shrinking in Africa during the Pliocene epoch, beginning roughly five million years ago, due to global cooling and drying. Unlike apes, australopiths were





Paranthropus boisei male skull with reconstructed chewing muscles. Graphite, pen and ink, and acrylic on board.

Opposite:
Paranthropus robustus male skull. Graphite on board.

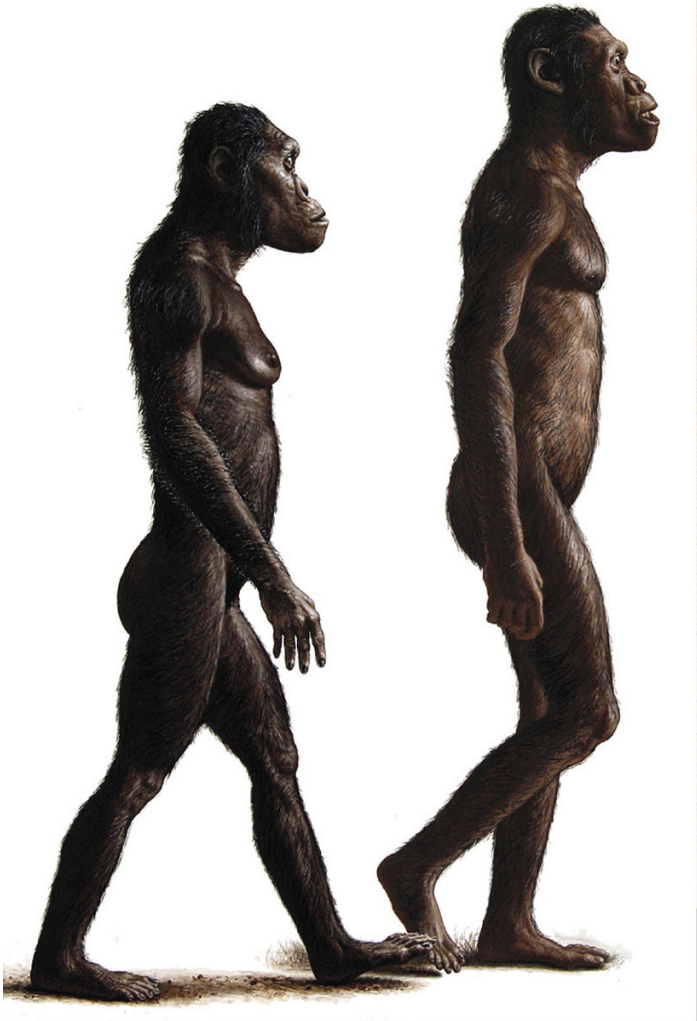
able to capitalize on this increasingly variable habitat with their unique way of moving from place to place on the ground and their ability to make a meal out of most anything they ran across. This gave them the edge over apes that made the difference in the long run, setting the stage for the arrival and evolution of *Homo*.

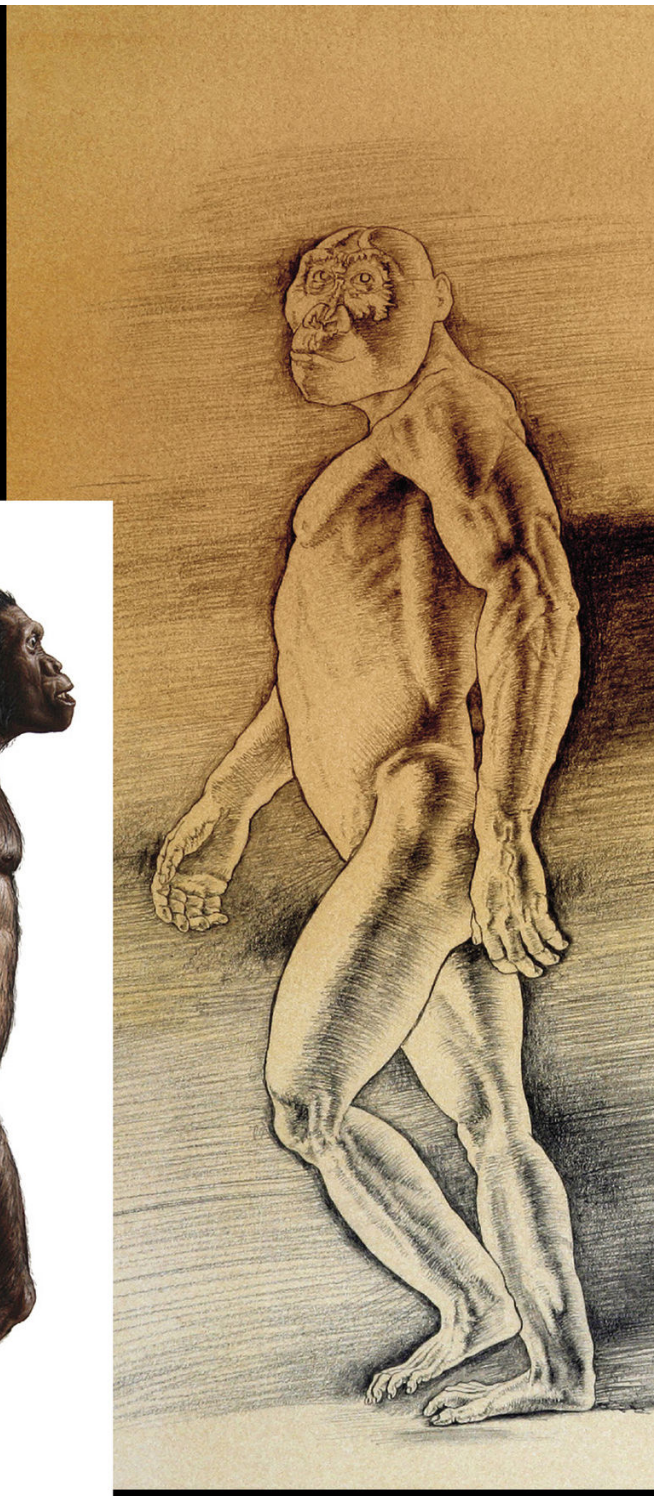
Some australopiths, often referred to as "robust" australopiths, or *Paranthropus*, took this heavy chewing adaptation to the extreme, with jaw muscles that would have been as large around as my wrist, and molar teeth that were up to three-quarters of an inch in diameter (pages 63 and 87). These species would not have evolved into *Homo*, but they lived alongside *Homo* for more than a million years. Robust australopiths are one of the best illustrations of species diversity in hominins.

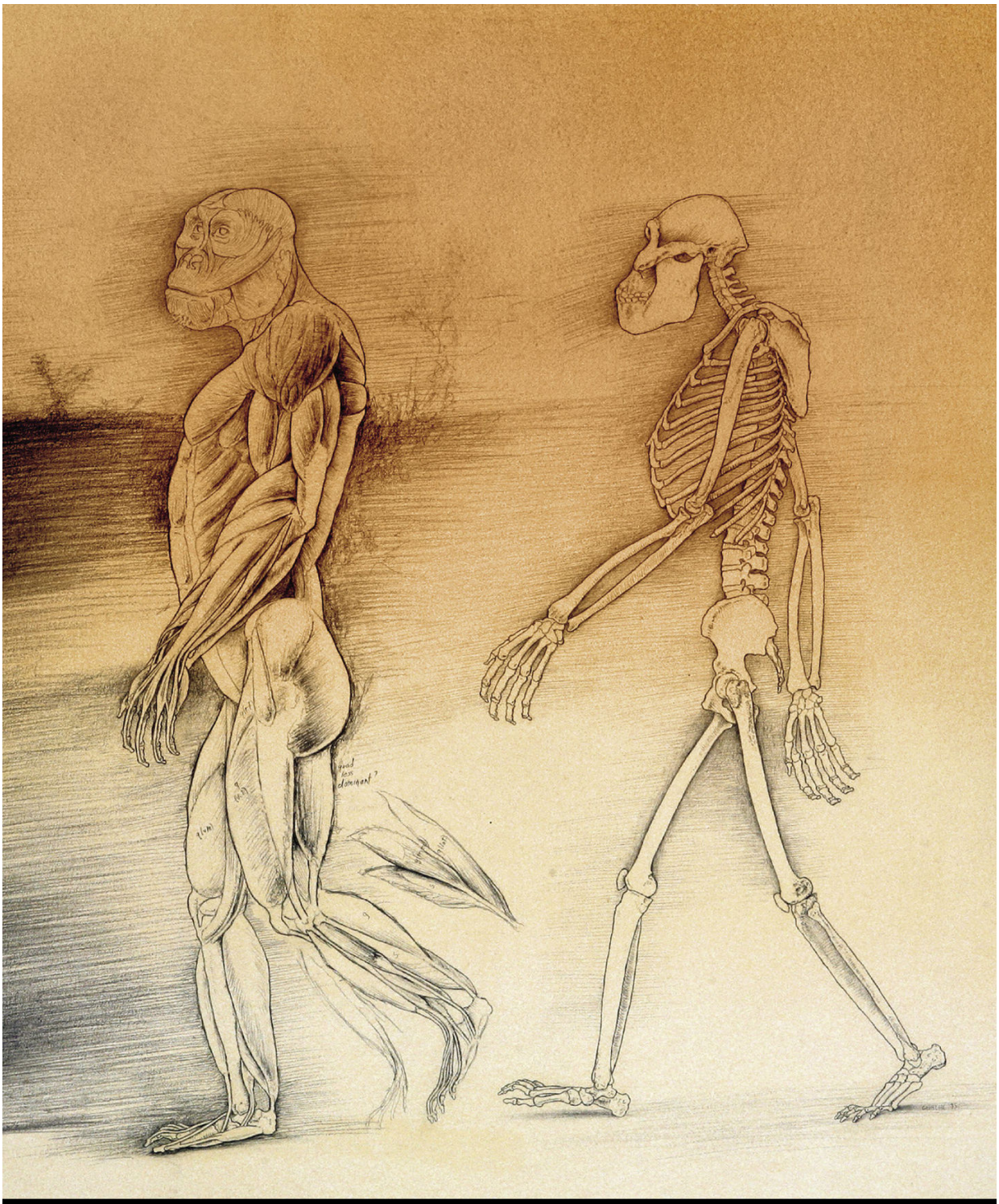
The hauntingly beautiful and thoughtful images in this chapter re-create what some of these australopiths would have looked like. Most of the art depicts only partial specimens—a single vertebra, the skeleton of a hand, part of a face. This is the fossil evidence we have. But many sketches go on to give us a glimpse of the careful, comparative scientific investigation that goes into reconstructing fossil hominins. Some drawings have incorporated this information to depict shadowy images of species known from only a handful of fossils. Some are based on a richer fossil record and depict nearly completely reconstructed animals complete with skin, hair, eyes, posture, and even movement and behavior (page 116). Each image is imbued with a passion for understanding our ancient relatives and evokes the wonder we scientists feel when we see australopith remains. Most of all, these drawings show vividly how the pieces we have of the australopith puzzle can be used to re-create a picture of this incredible chapter in our human story.

Below:
Australopithecus afarensis adult female (Lucy) and *Australopithecus sediba* juvenile male. Acrylic and ink on gessoed Masonite.

Opposite:
Australopithecus afarensis male reconstructed skeleton, musculature, and figure walking. Digitally altered graphite on acrylic-washed board.

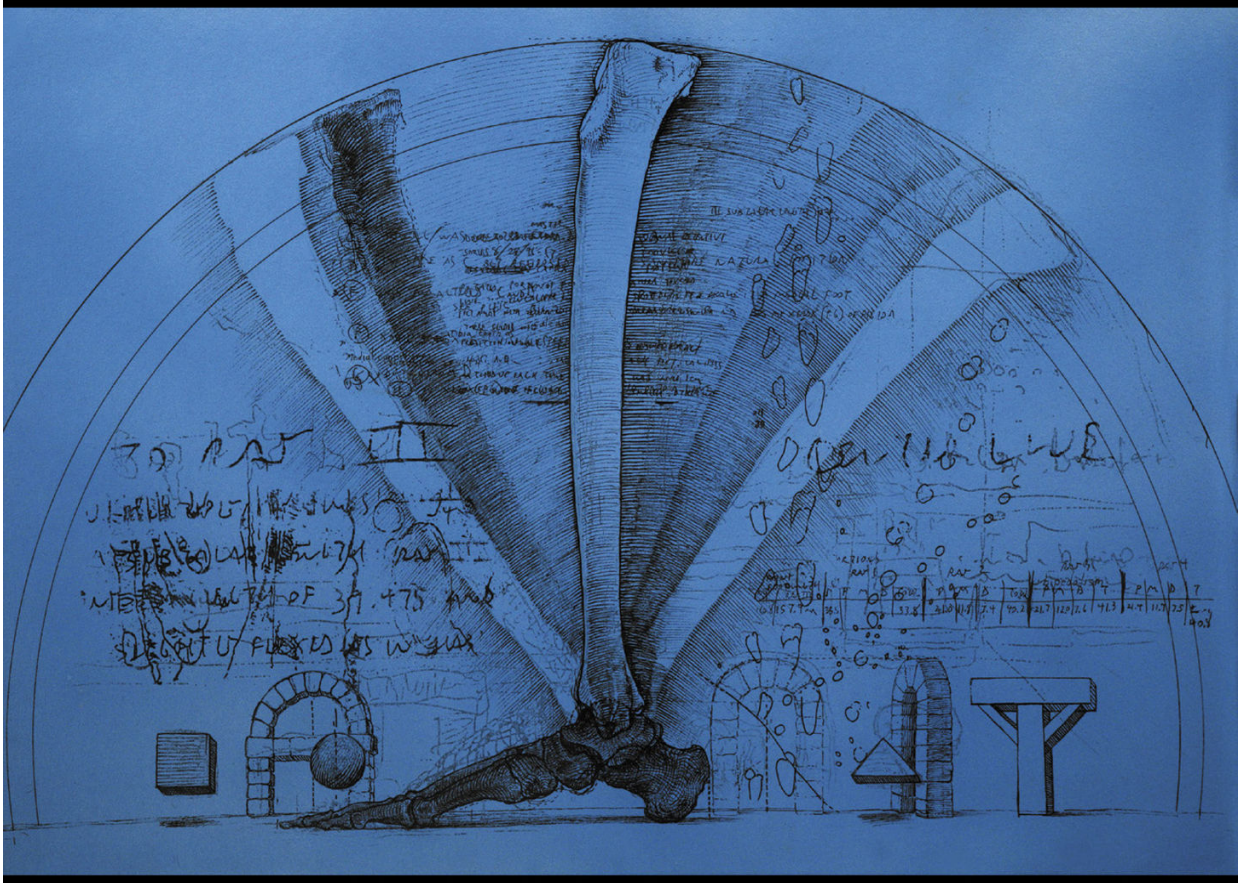






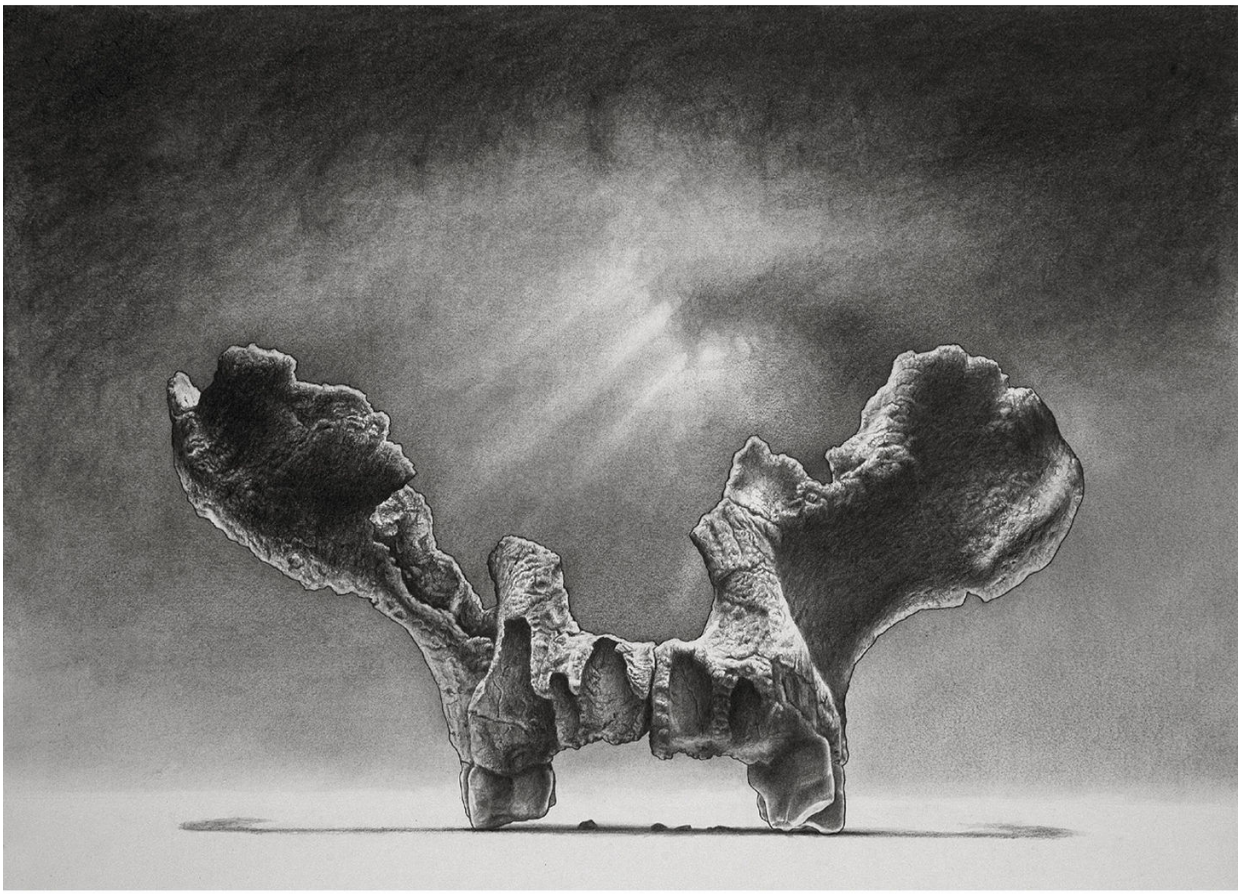
Australopithecus afarensis female (Lucy). Graphite, ink, chalk, and acrylic.

Opposite:
Australopithecus afarensis composite foot skeleton, composed of elements known as of 2016. Graphite on board.



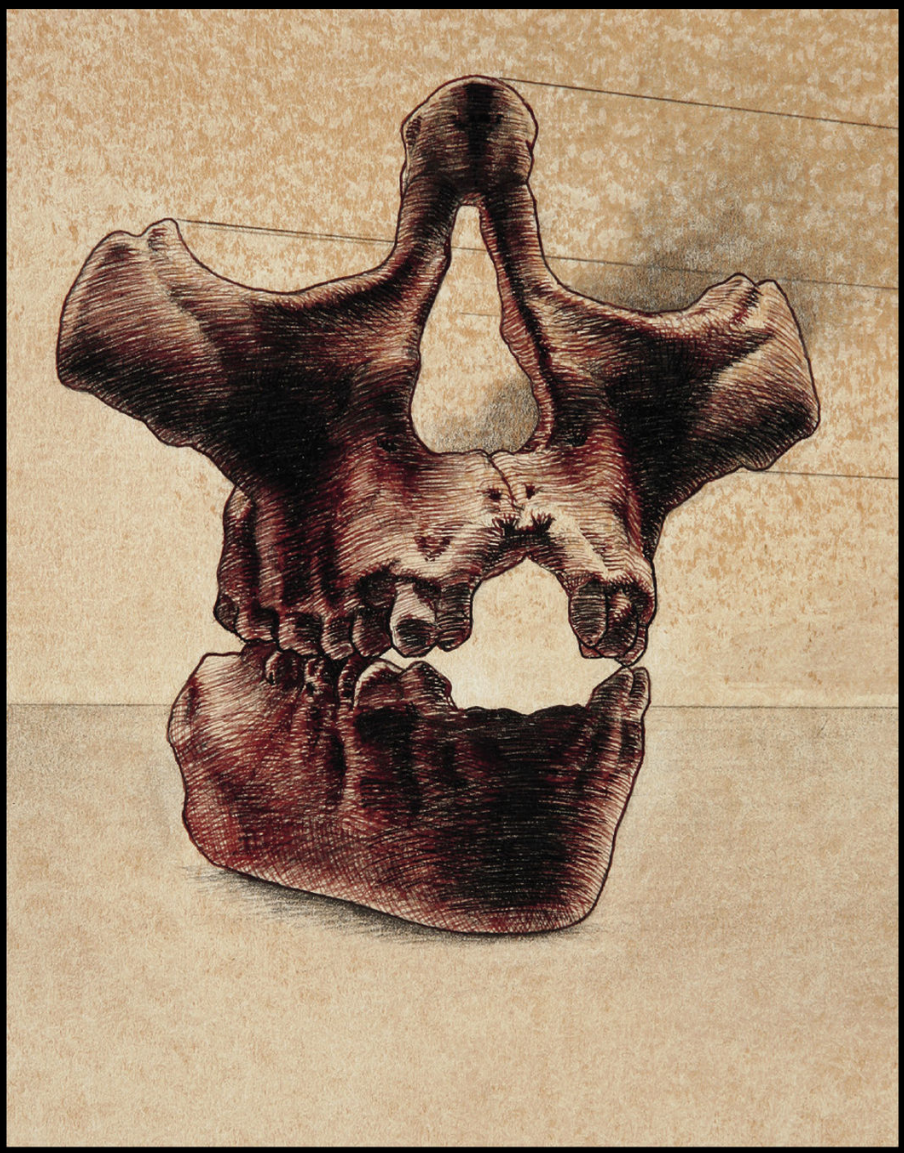
Above and right:
Australopithecus afarensis reconstructed feet. Graphite (above) and red chalk (right).

Opposite:
Australopithecus afarensis foot skeleton and tibia. Graphite drawing Xerox-transferred onto acrylic-washed board, with ink.



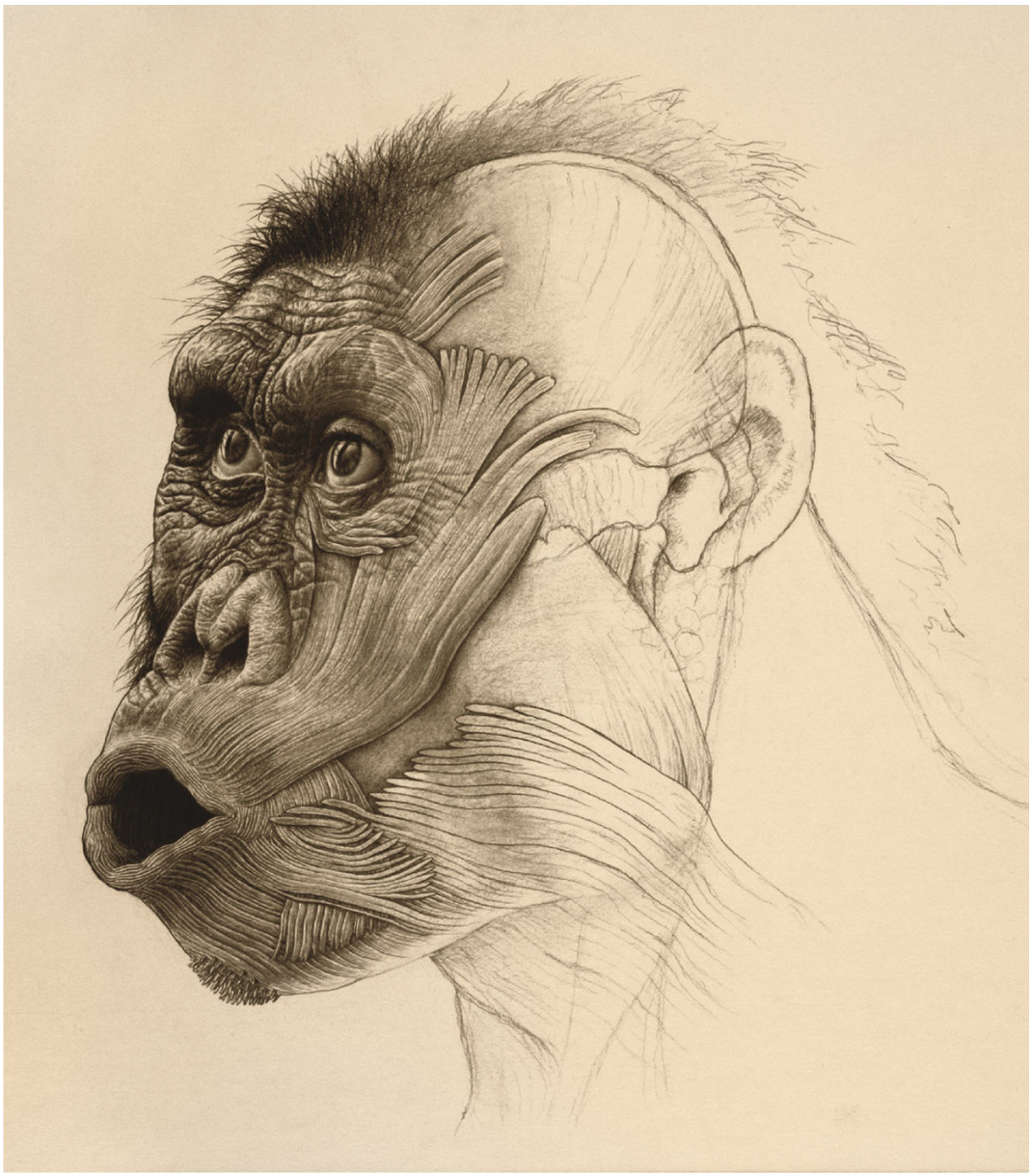
Australopithecus afarensis adult partial facial skeleton. Graphite on board.

Opposite:
Australopithecus afarensis child's skull. Acrylic and ink on board.



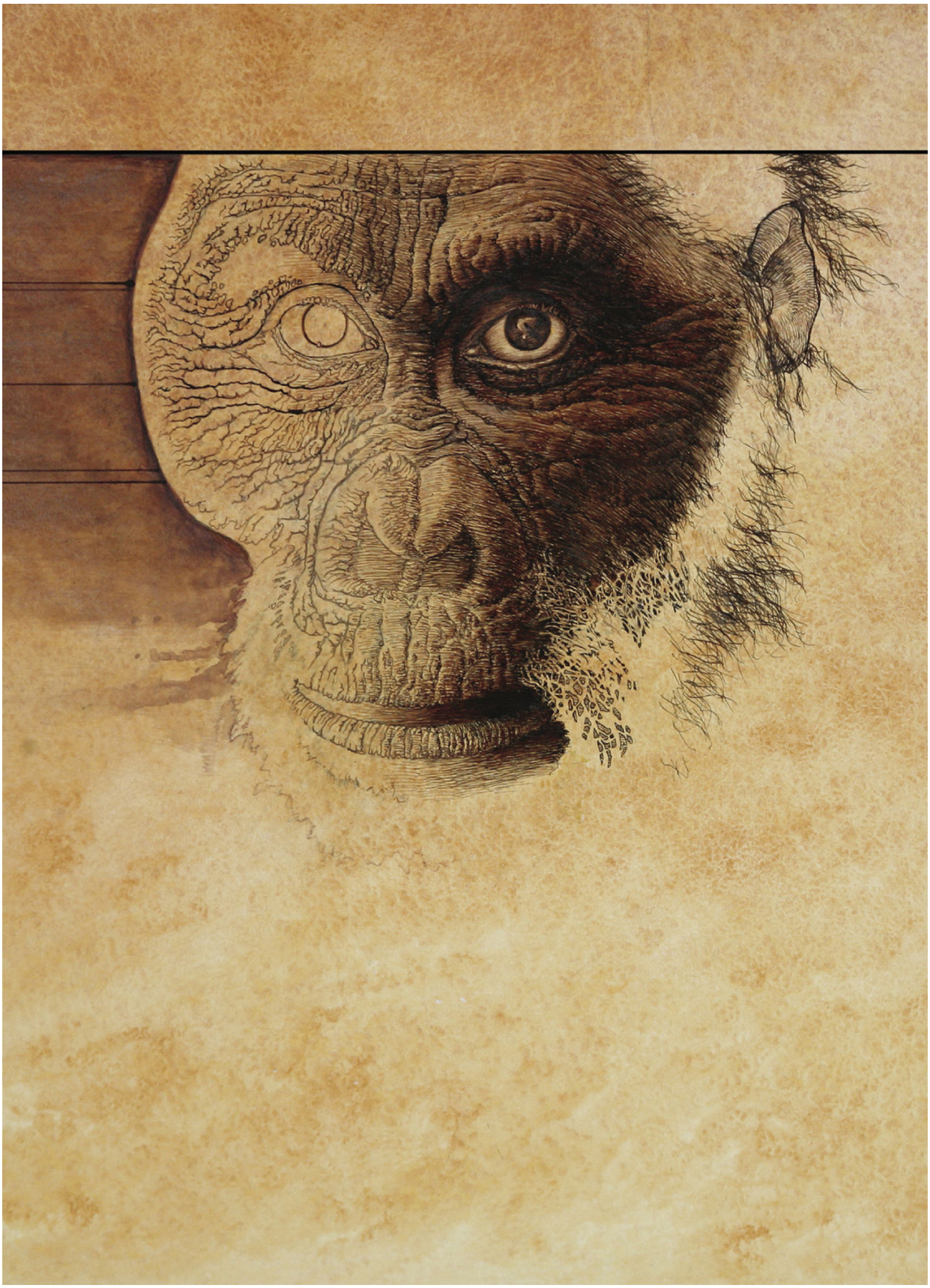
Australopithecus afarensis adult female facial skeleton, with missing portions mirror-imaged. Pen and ink on acrylic-washed board.

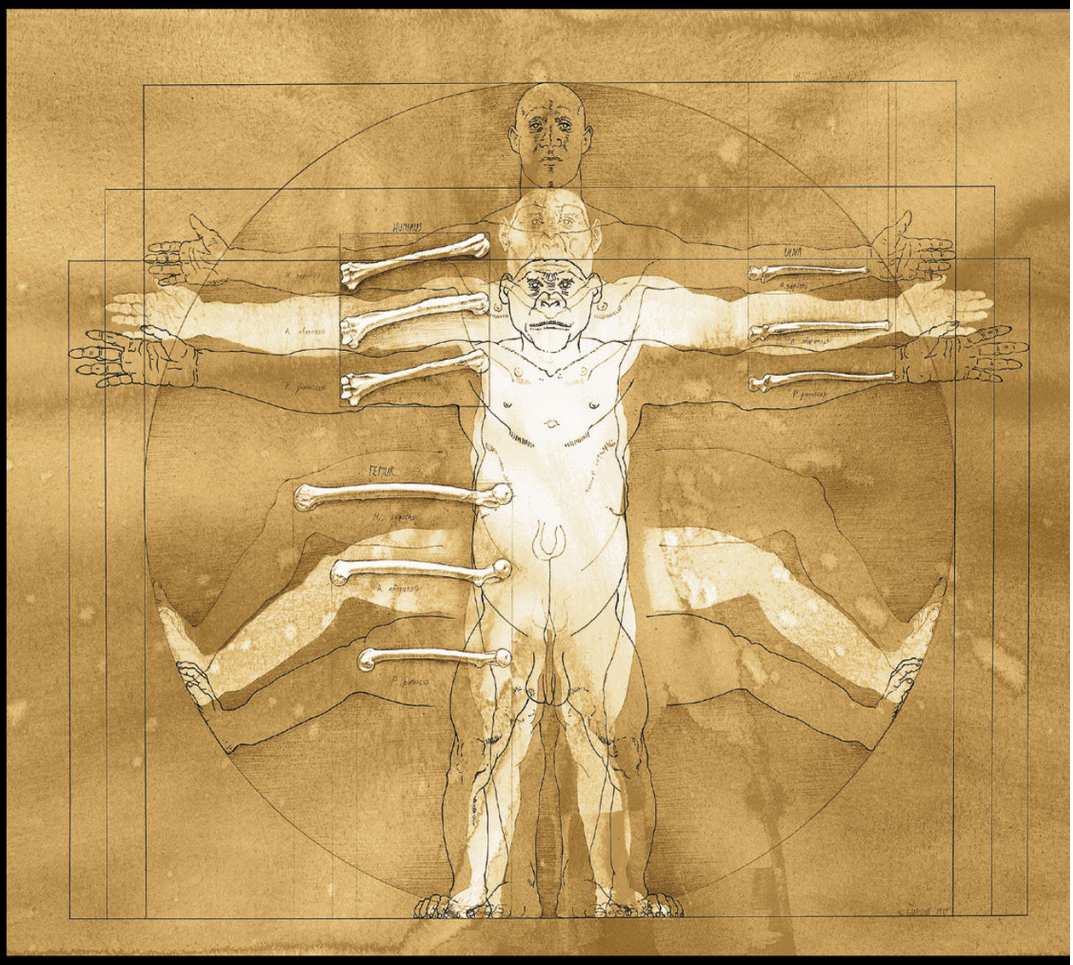
Opposite:
Australopithecus afarensis adult male skull. Pen and ink on acrylic-washed board.



Australopithecus afarensis (male) reconstructed muscles of facial expression. Digitally altered graphite on board.

Opposite:
Australopithecus afarensis male face in construction. Xerox-transferred graphite drawing with pen and ink on acrylic-washed board.





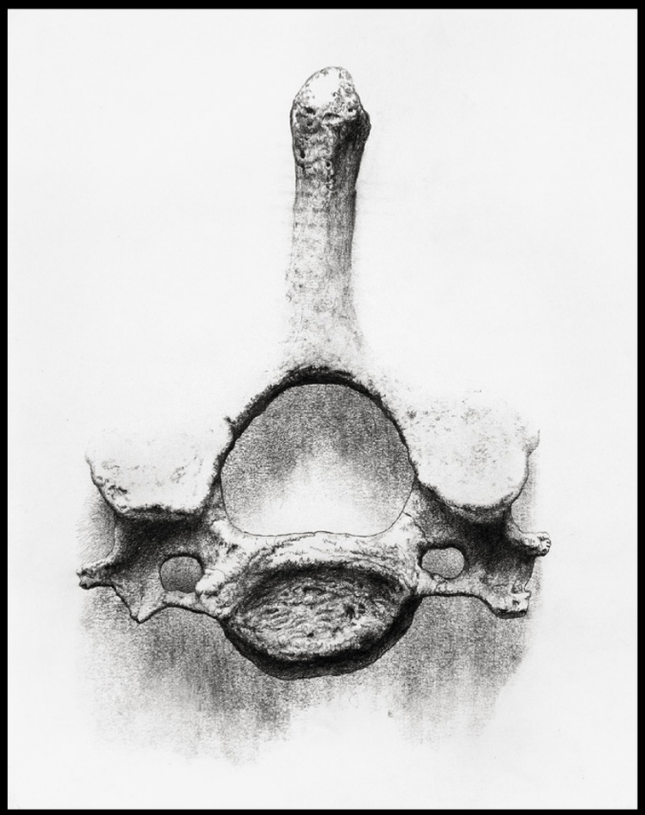
Body proportions in adult male ***Australopithecus afarensis*** (lighter color) in comparison with those of ***Pan troglodytes*** (chimpanzee) and ***Homo sapiens,*** all scaled to the same humerus length. Pen and ink with acrylic on board.

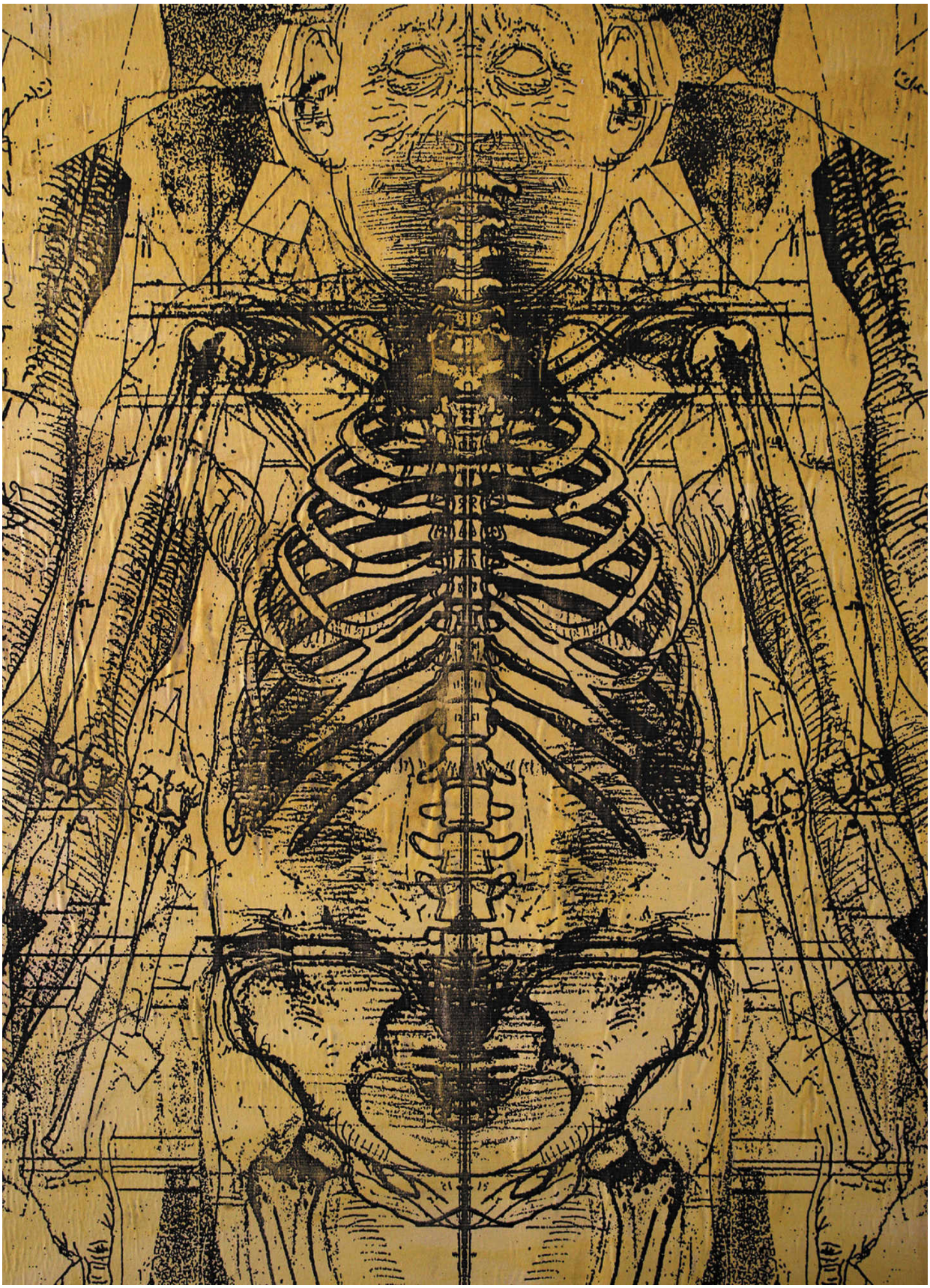
Opposite:
Australopithecus afarensis (male) face. Pen and ink on acrylic-washed board.

Left:
Australopithecus afarensis (Lucy) reconstructed pelvis. Red chalk on acrylic-washed board.

Below:
Australopithecus afarensis seventh cervical vertebra. Graphite on paper.

Opposite:
Australopithecus afarensis female figure in construction. Manipulation of Xeroxed-on-acetate anatomical drawings, transferred onto acrylic-washed board.



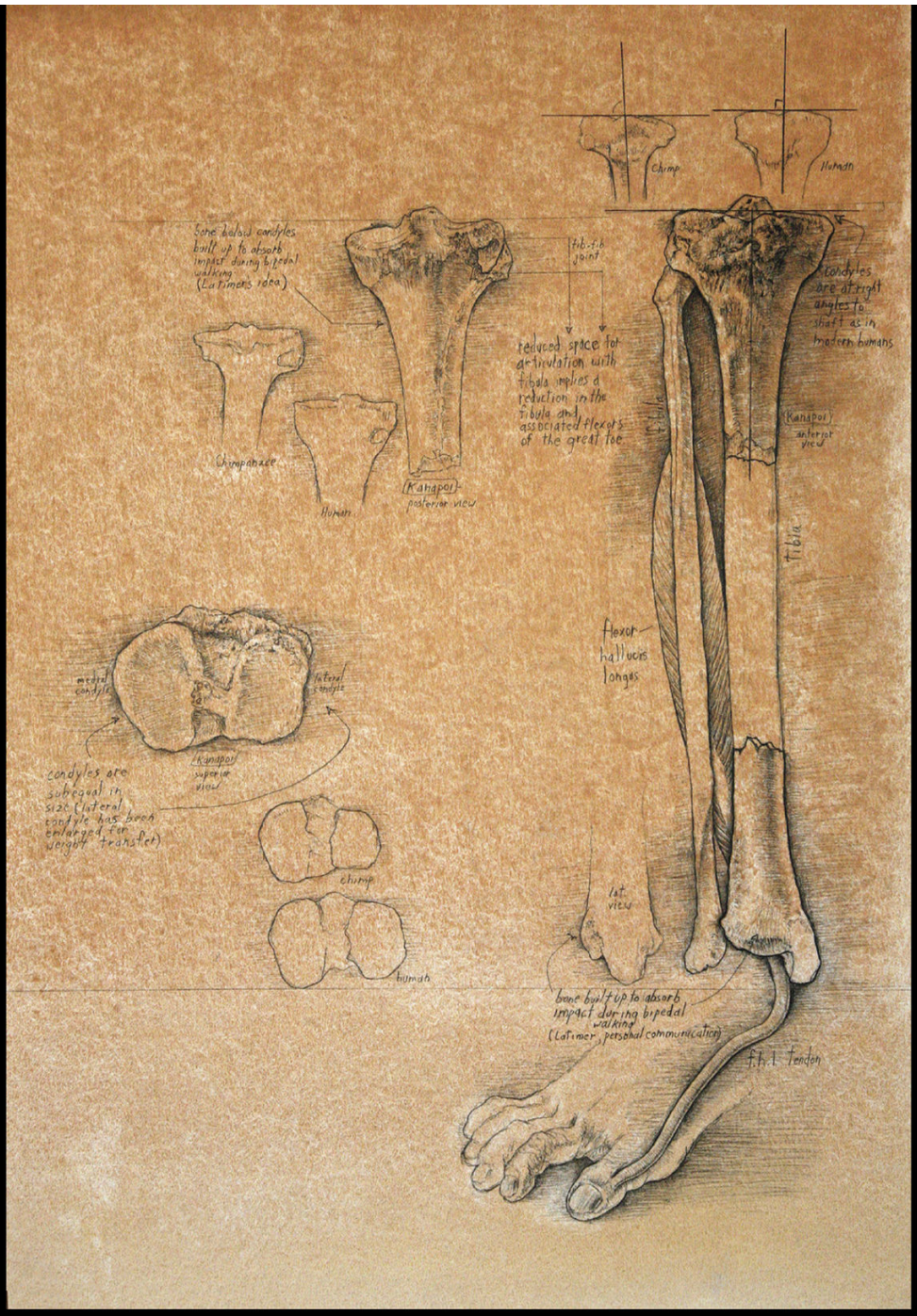


Australopithecus afarensis female (Lucy). Acrylic and graphite with pen and ink on board.

Opposite:
Australopithecus afarensis female (Lucy). Graphite on paper.

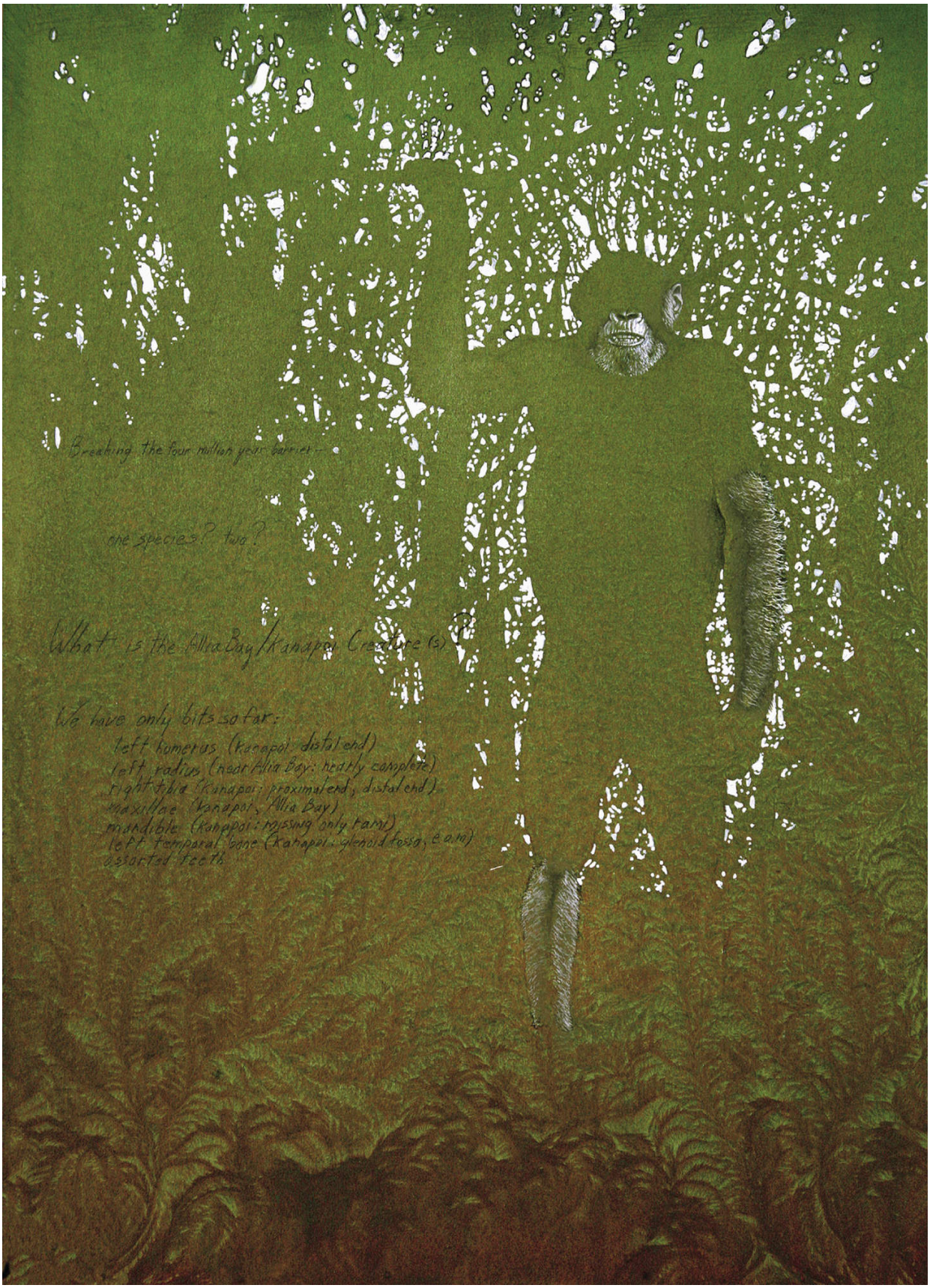
Above:
Australopithecus anamensis mandible in parallax-distorted view. Graphite on paper

Left:
Australopithecus afarensis adult male and female with child. Ink, acrylic, and digital drawing.



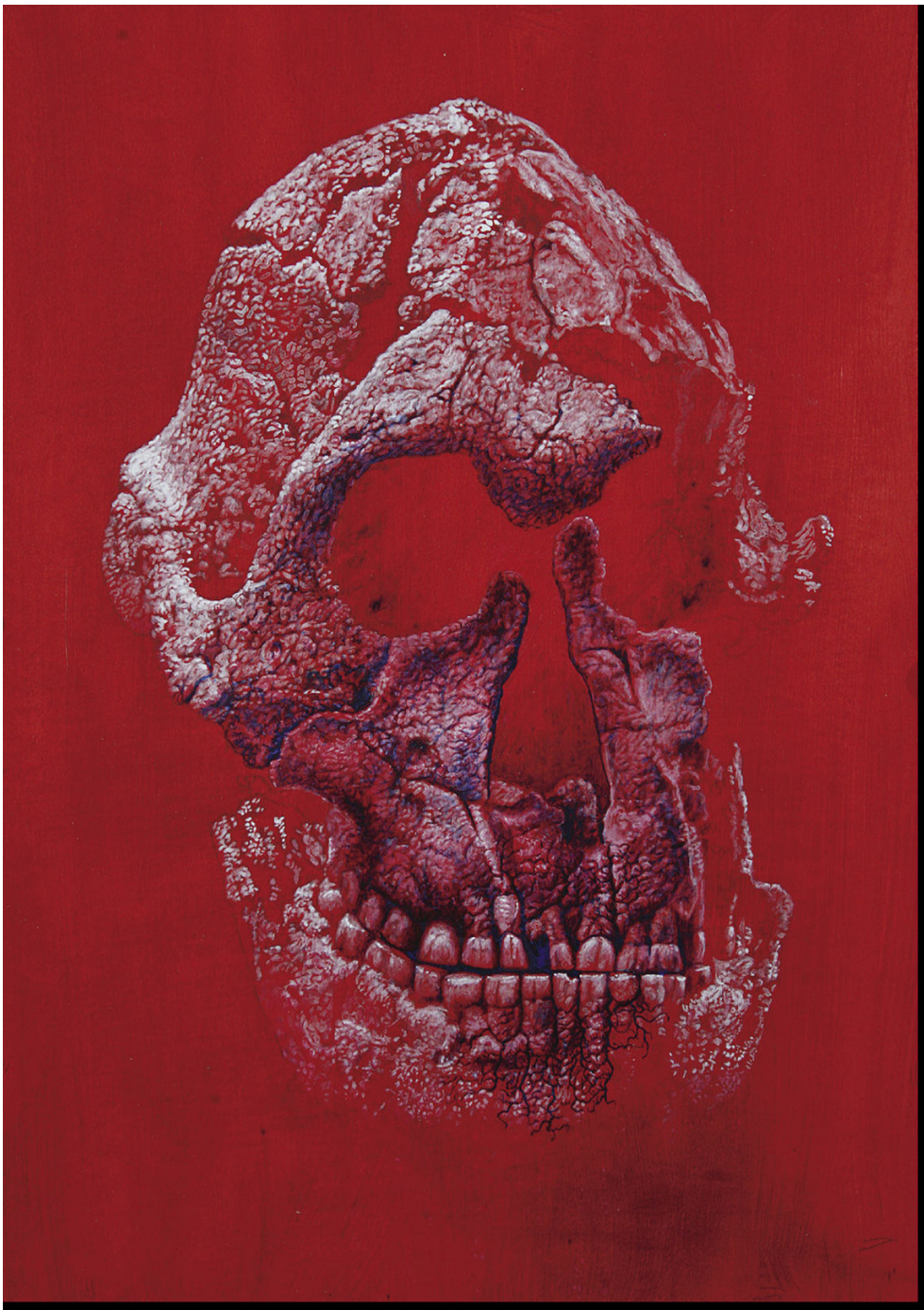
Australopithecus anamensis tibia with reconstructed muscle and tendon. Graphite on acrylic-washed board.

Opposite:
Australopithecus anamensis silhouette, with known portions highlighted. Acrylic and graphite on acrylic-washed and frost-treated board.


Breaking the four million year barrier...
one species? two?
What is the Allia Bay/Kanapoi Creature(s)
We have only bits so far:
left humerus (Kanapoi: distal end)
left radius (near Allia Bay: nearly complete)
right tibia (Kanapoi: proximal end, distal end)
maxillae (Kanapoi, Allia Bay)
mandible (Kanapoi: missing only rami)
left temporal bone (Kanapoi: glenoid fossa, e.a.m)
assorted teeth

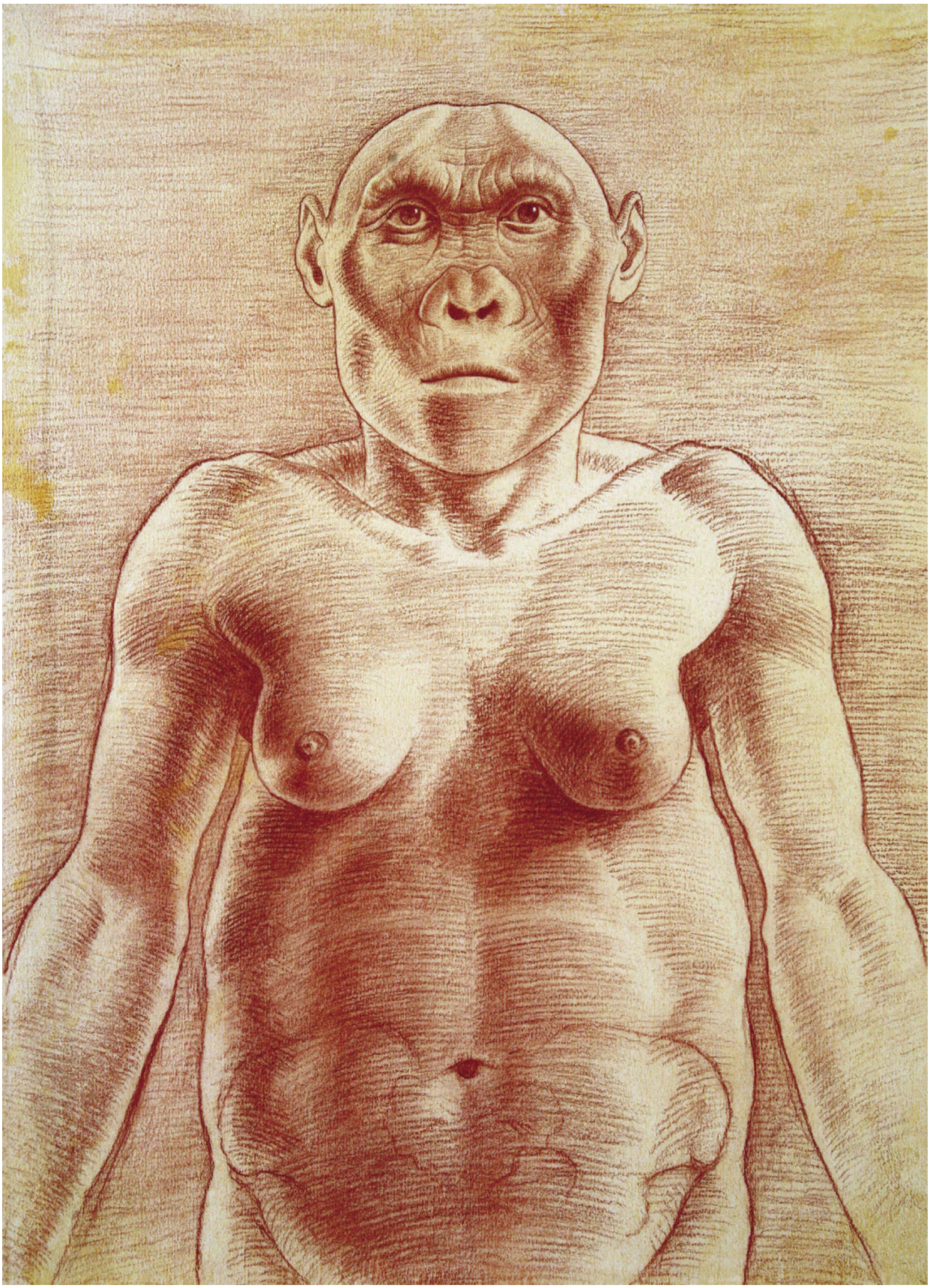
Paranthropus robustus adult male skull. Graphite on paper.

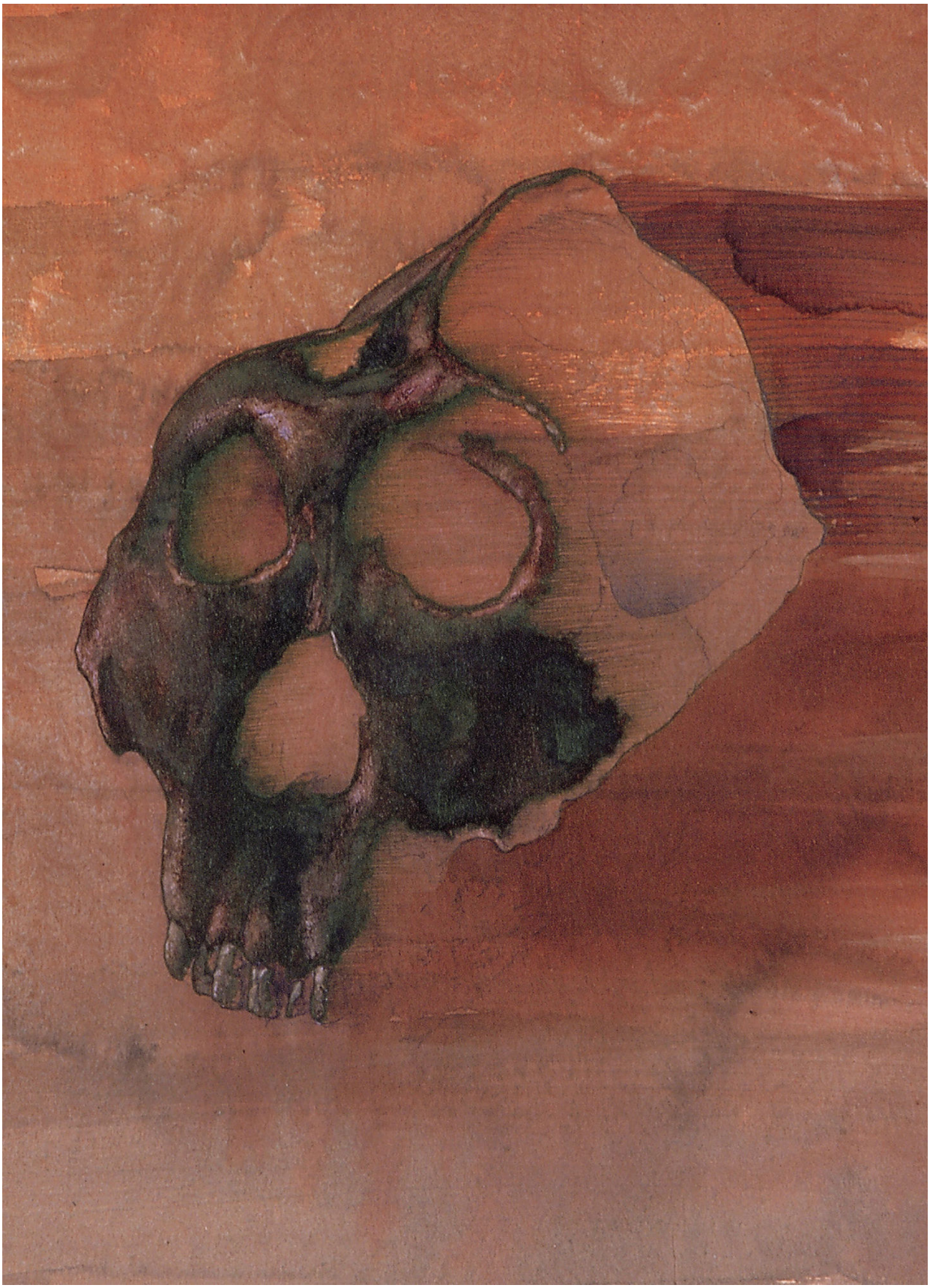
Opposite:
Australopithecus anamensis maxilla and mandibles. Graphite on acrylic-washed and frost-treated board.

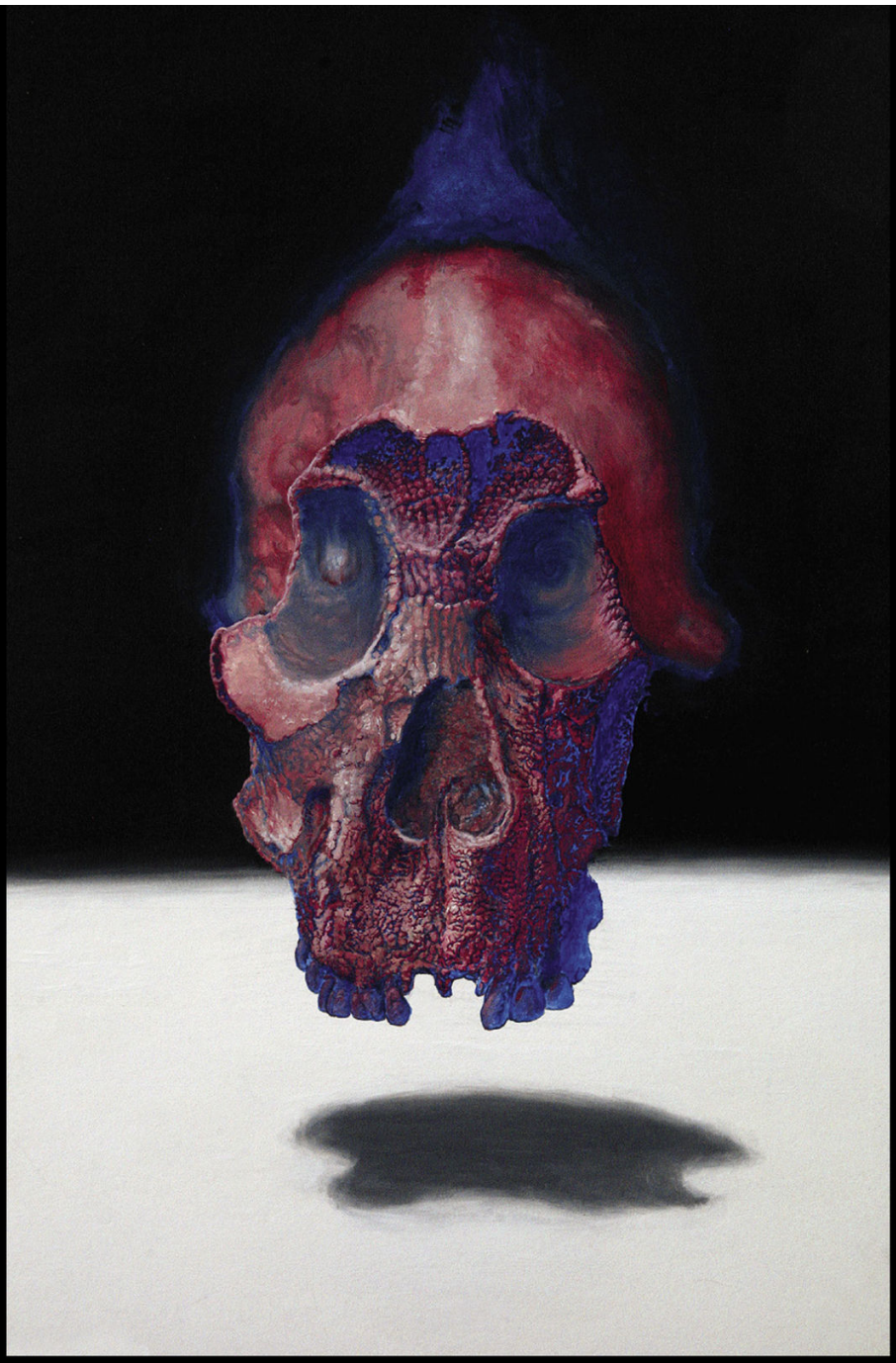


Paranthropus robustus adult female skull. Acrylic and ink on acrylic-painted board.

Opposite:
Paranthropus robustus adult female. Red chalk on acrylic-washed board.





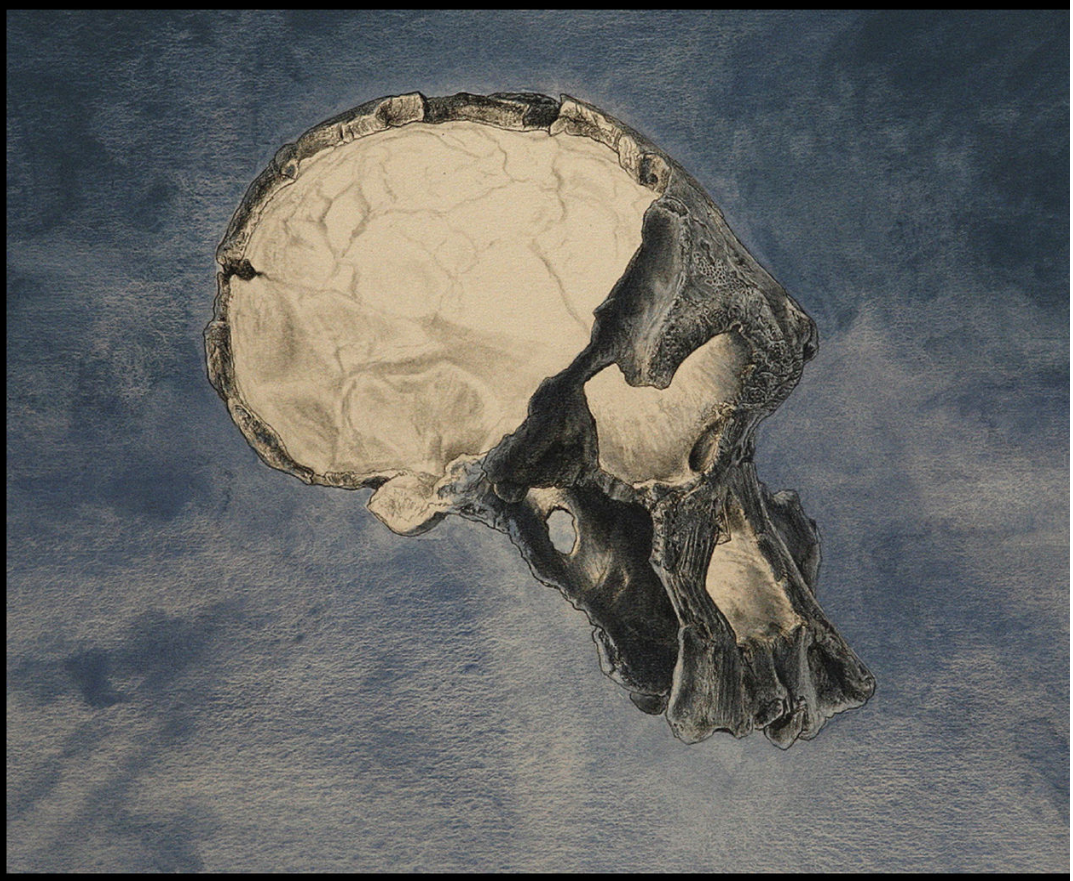


Paranthropus boisei male skull. Ink and acrylic on acrylic-painted board.

Opposite:
Paranthropus boisei male skull. Ink washes on acrylic-washed board.

Paranthropus boisei male. Watercolor and water-soluble ink over acrylic-washed board.

Opposite:
Paranthropus boisei male reconstruction in progress. Graphite, ink, and acrylic on acrylic-washed board.

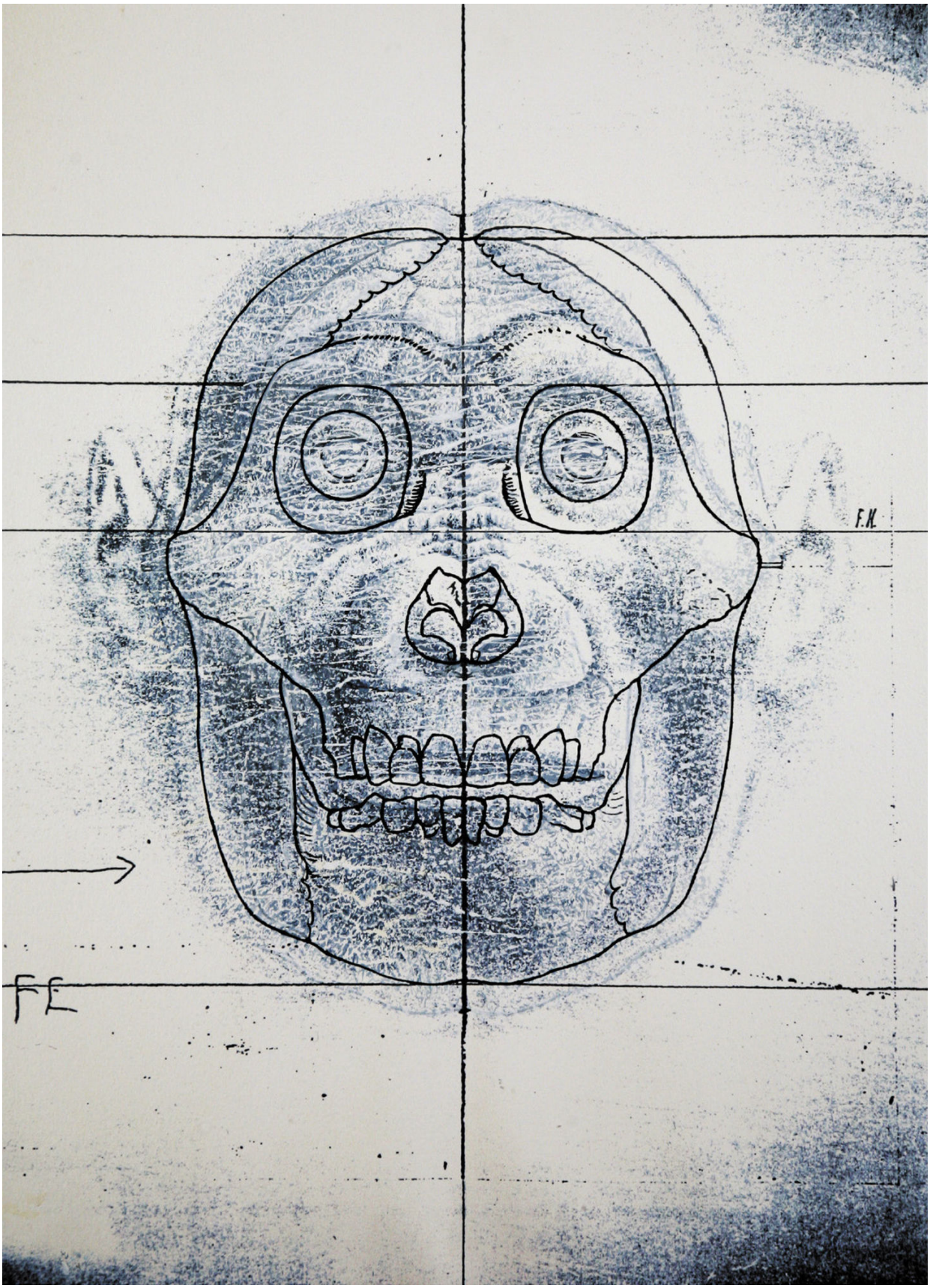


Australopithecus africanus male skull. Graphite and acrylic on board.

Opposite:
Australopithecus africanus skull. Acrylic and ink on board.

Australopithecus africanus male skull. Ink wash on acrylic- and sand-washed board.

Opposite:
Australopithecus africanus subadult facial skeleton. Pen and ink on acrylic- and sand-washed board.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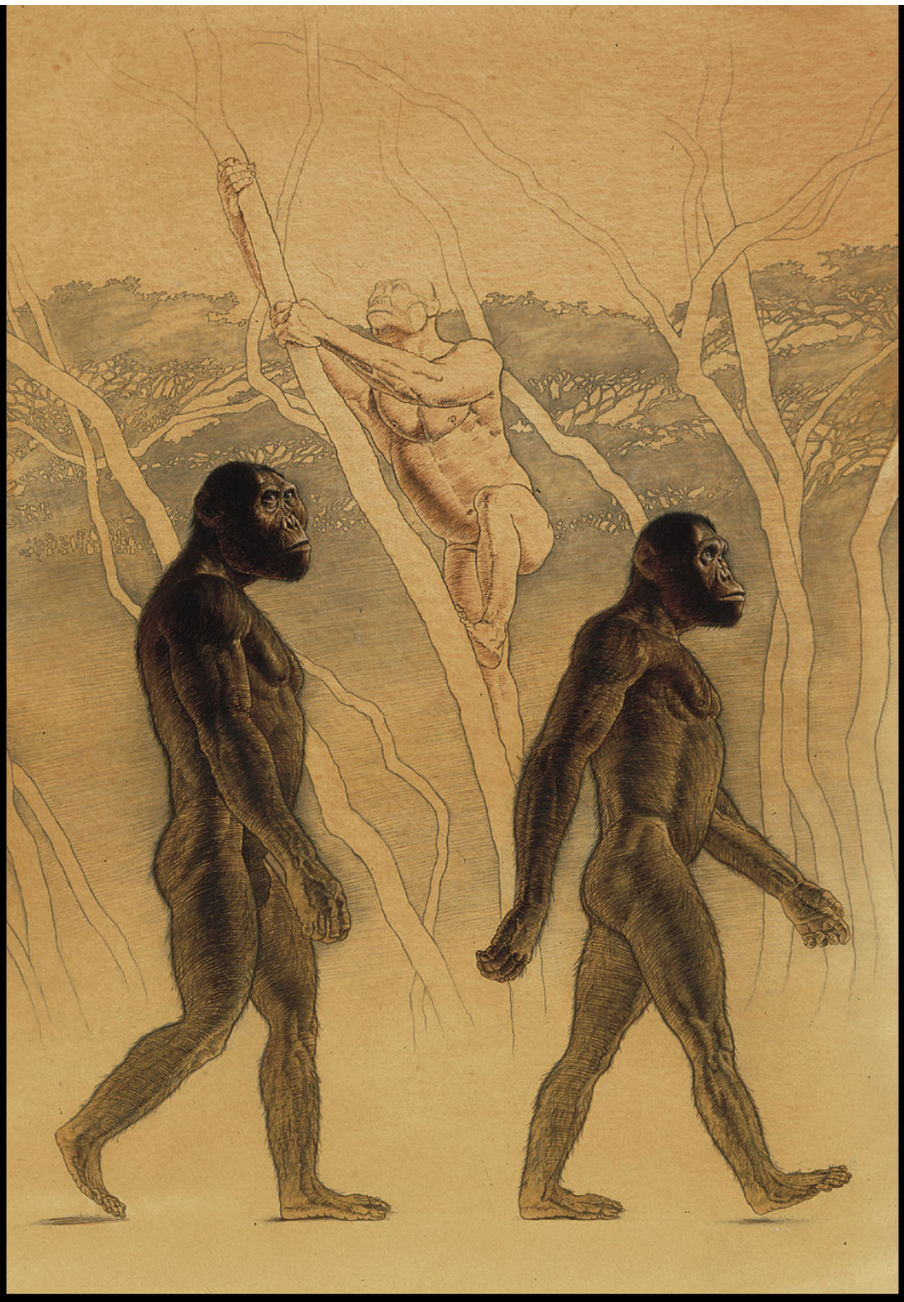
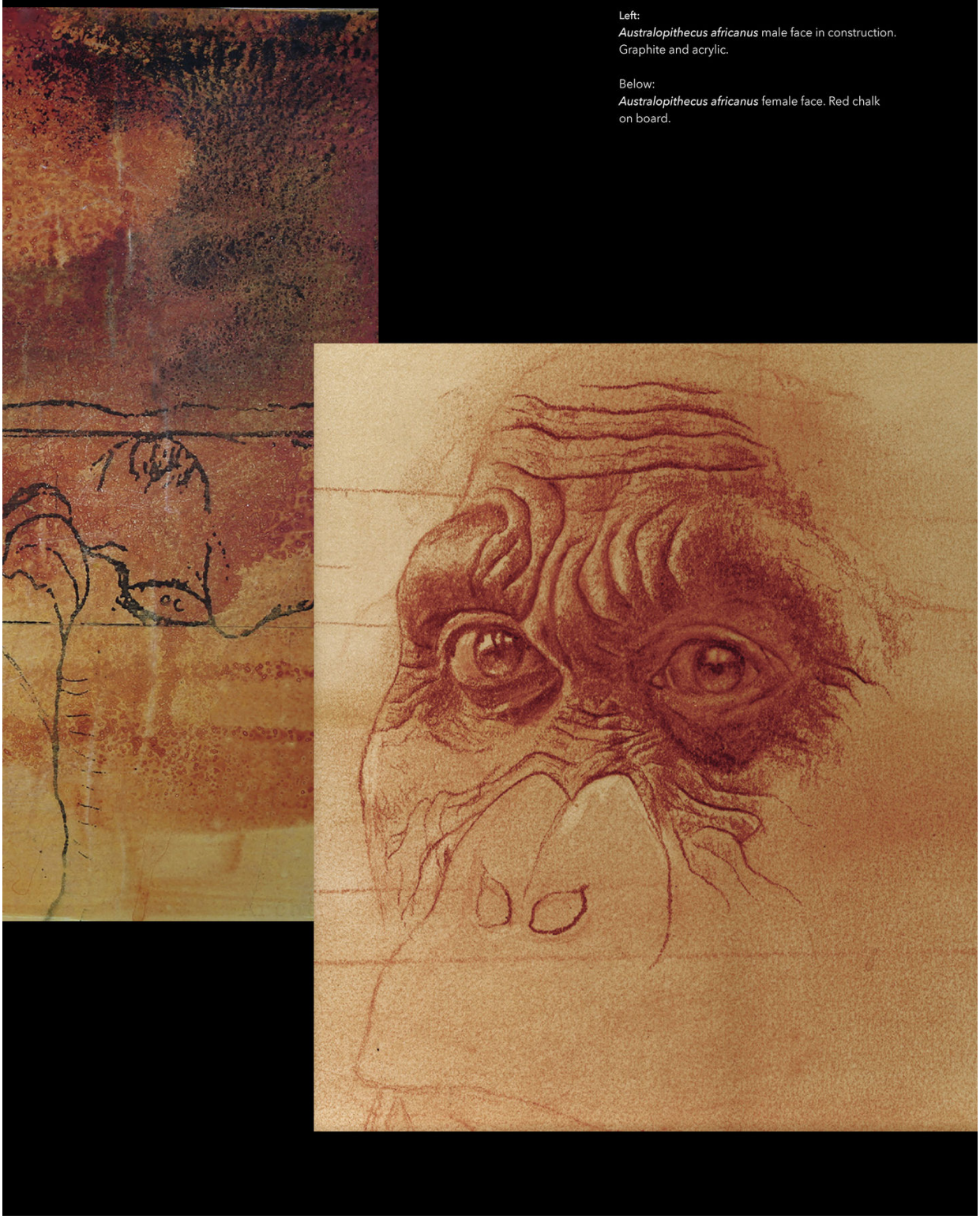


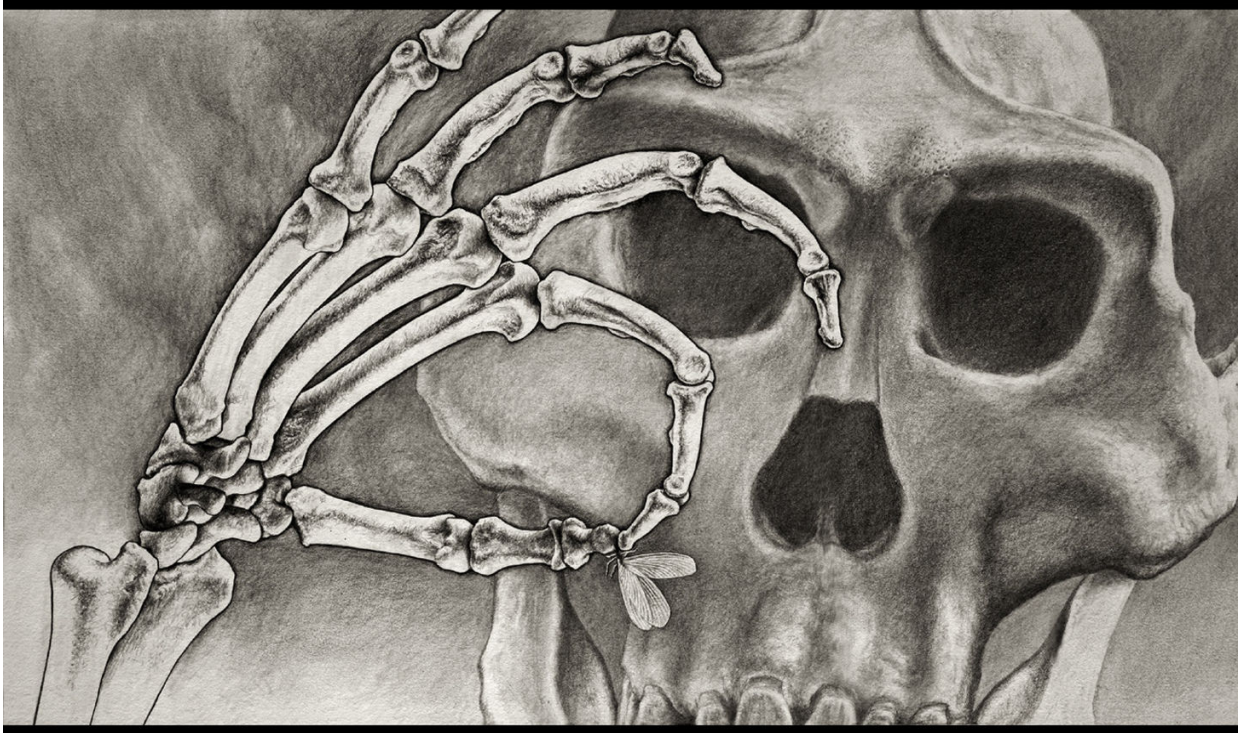
Australopithecus afarensis (left) and ***Australopithecus africanus*** males walking, with climbing figure. Pen and ink with graphite on acrylic-washed board.

Opposite:
Australopithecus africanus male skull and deep-face anatomy outlines, with reconstructed face ghosted-in. Manipulation of graphite drawings with added acrylic.



Left:
Australopithecus africanus male face in construction. Graphite and acrylic.

Below:
Australopithecus africanus female face. Red chalk on board.



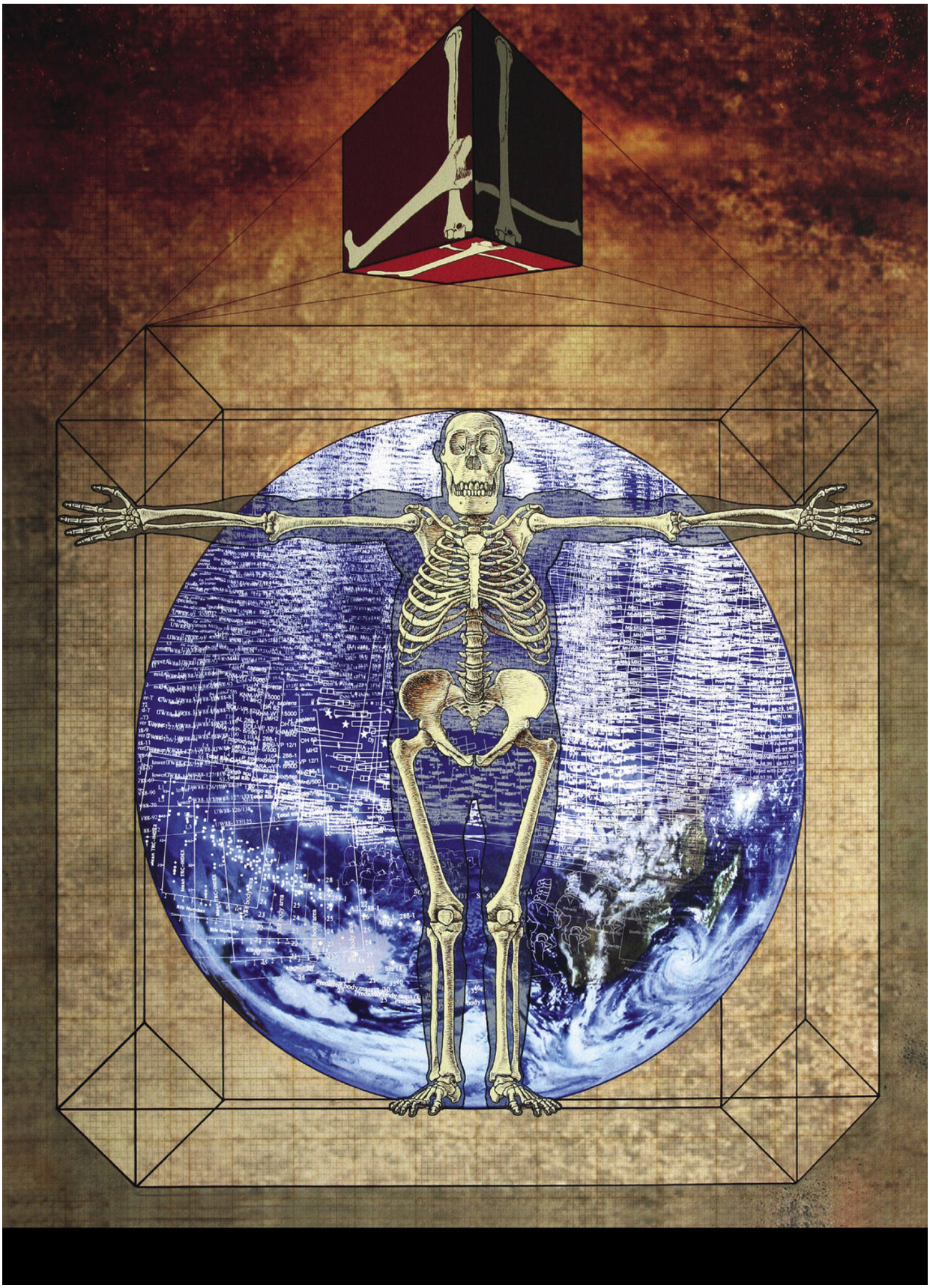
Australopithecus afarensis male skeleton with termite.
Graphite on board.

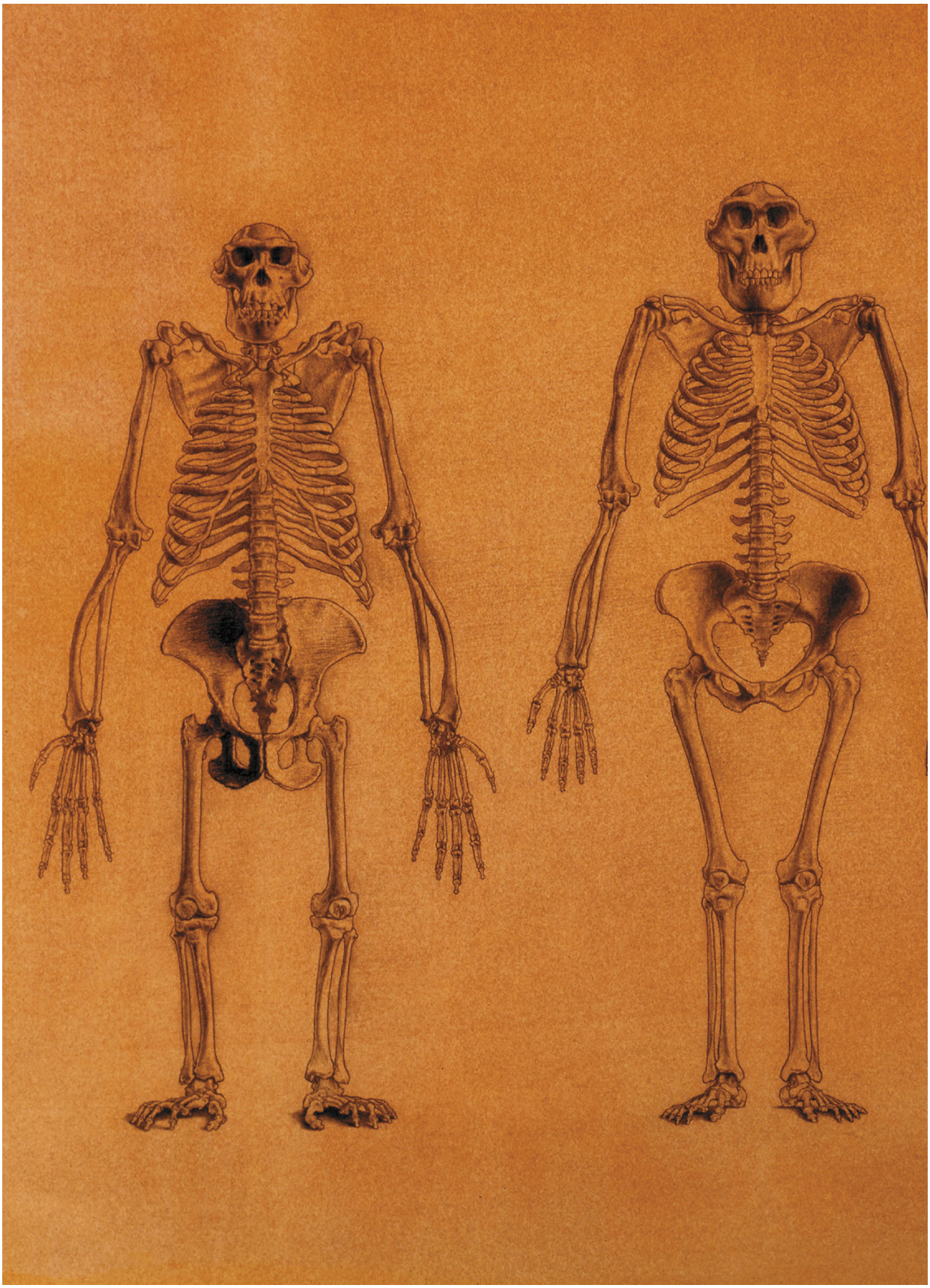
Opposite:
Australopithecus afarensis hand with egg. Red chalk
on paper.

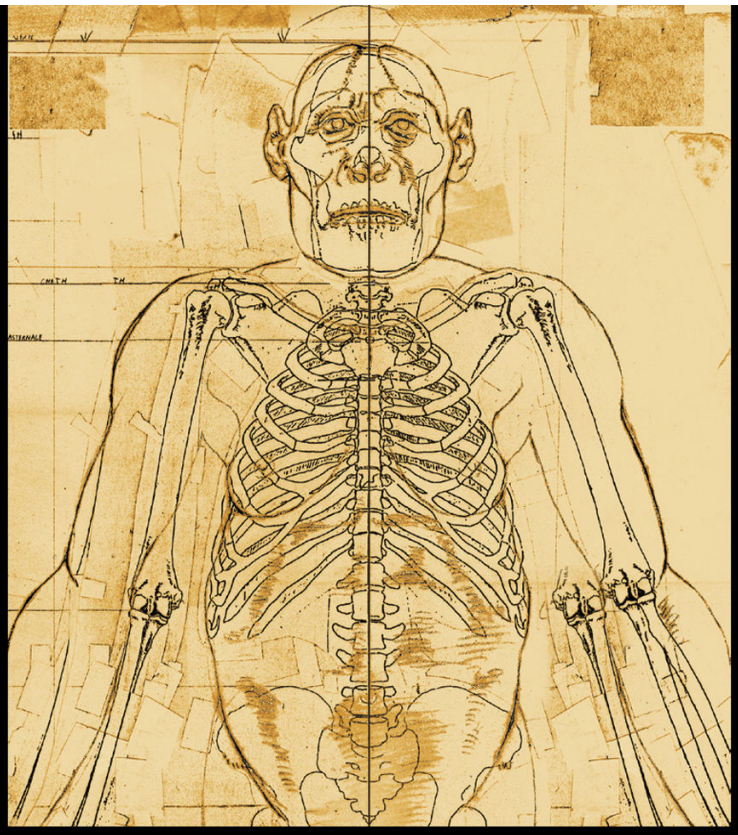
Australopithecus sediba female, skeleton of the shoulder, arm, and hand. Graphite drawing on board, digitally colored.

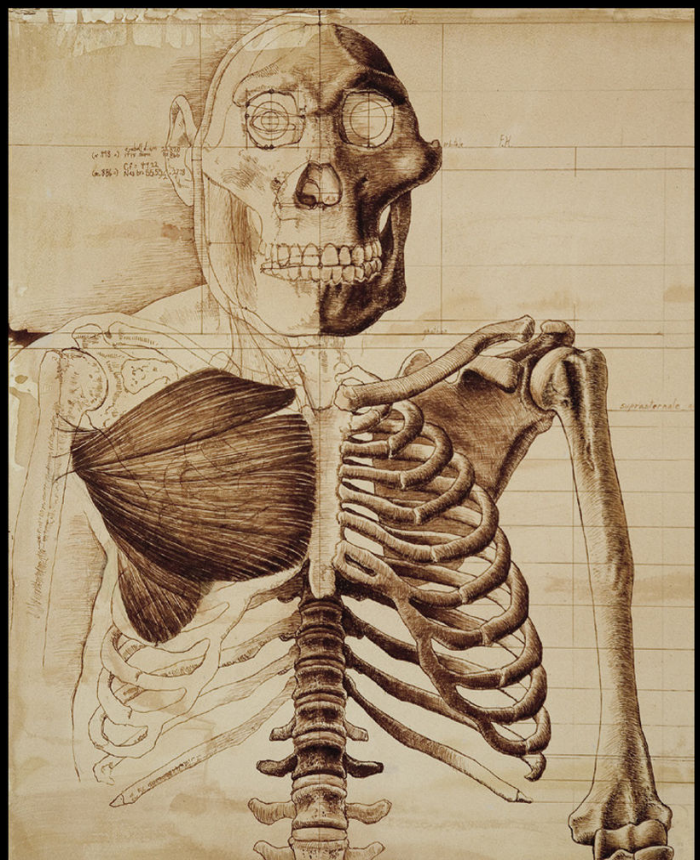
Opposite:
Australopithecus sediba reconstructed skeleton with symbols of the current state of the sciences. Ink, acrylic, and digital.

Overleaf:
Skeletons of (left to right) ***Pan troglodytes*** (chimpanzee), ***Australopithecus afarensis, Australopithecus africanus,*** and ***Homo sapiens*** males. Graphite on acrylic-washed board.





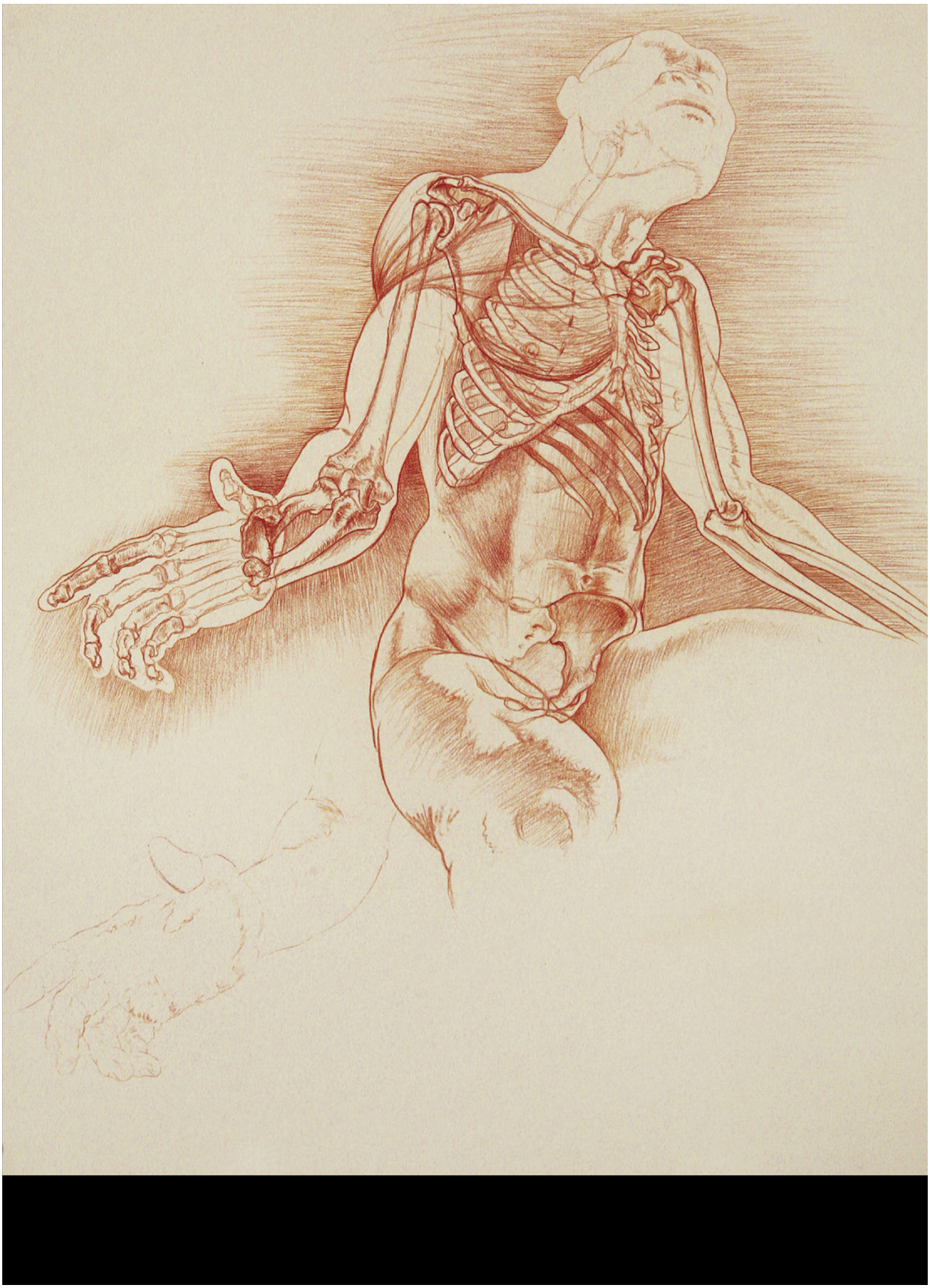


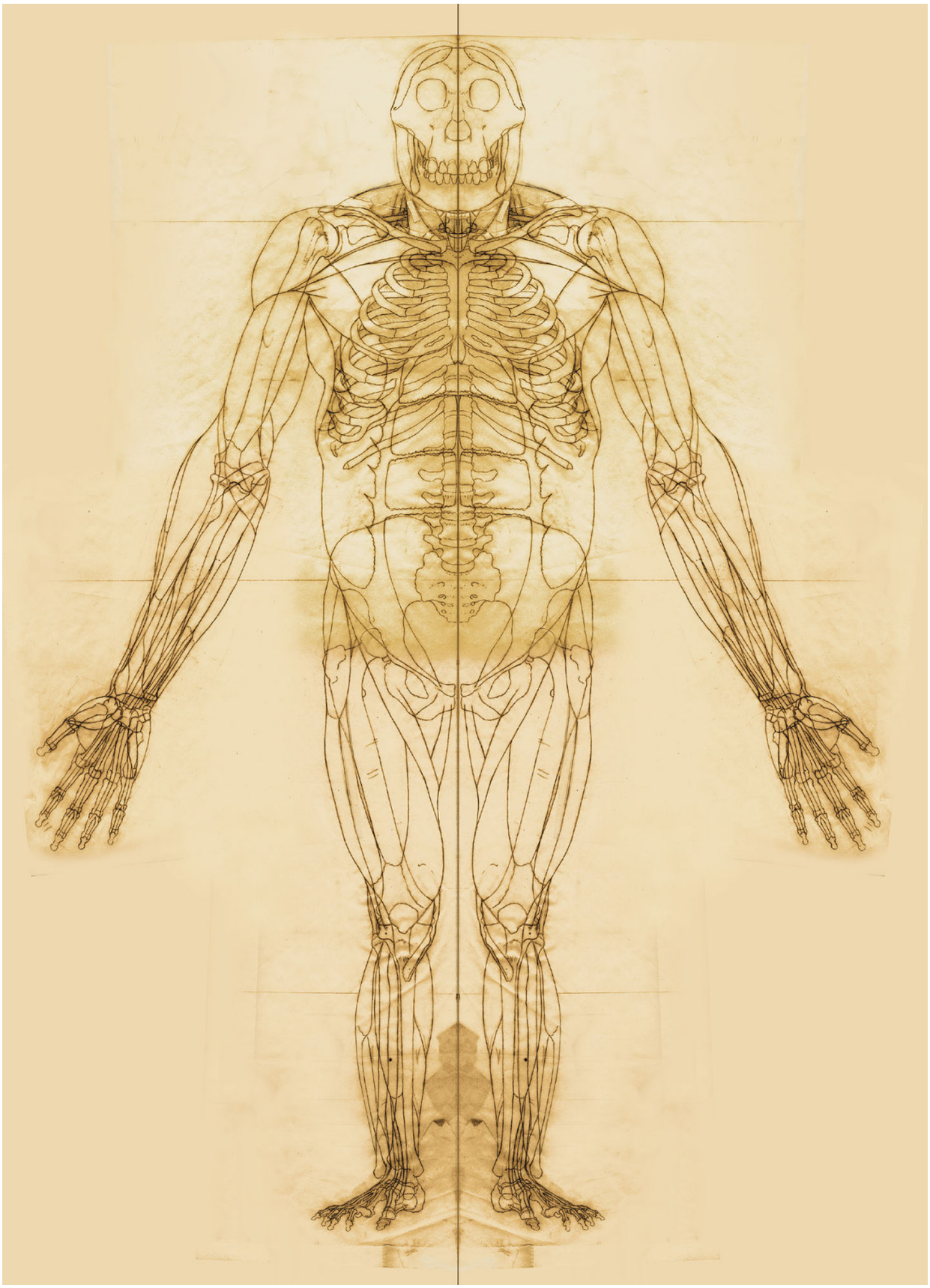


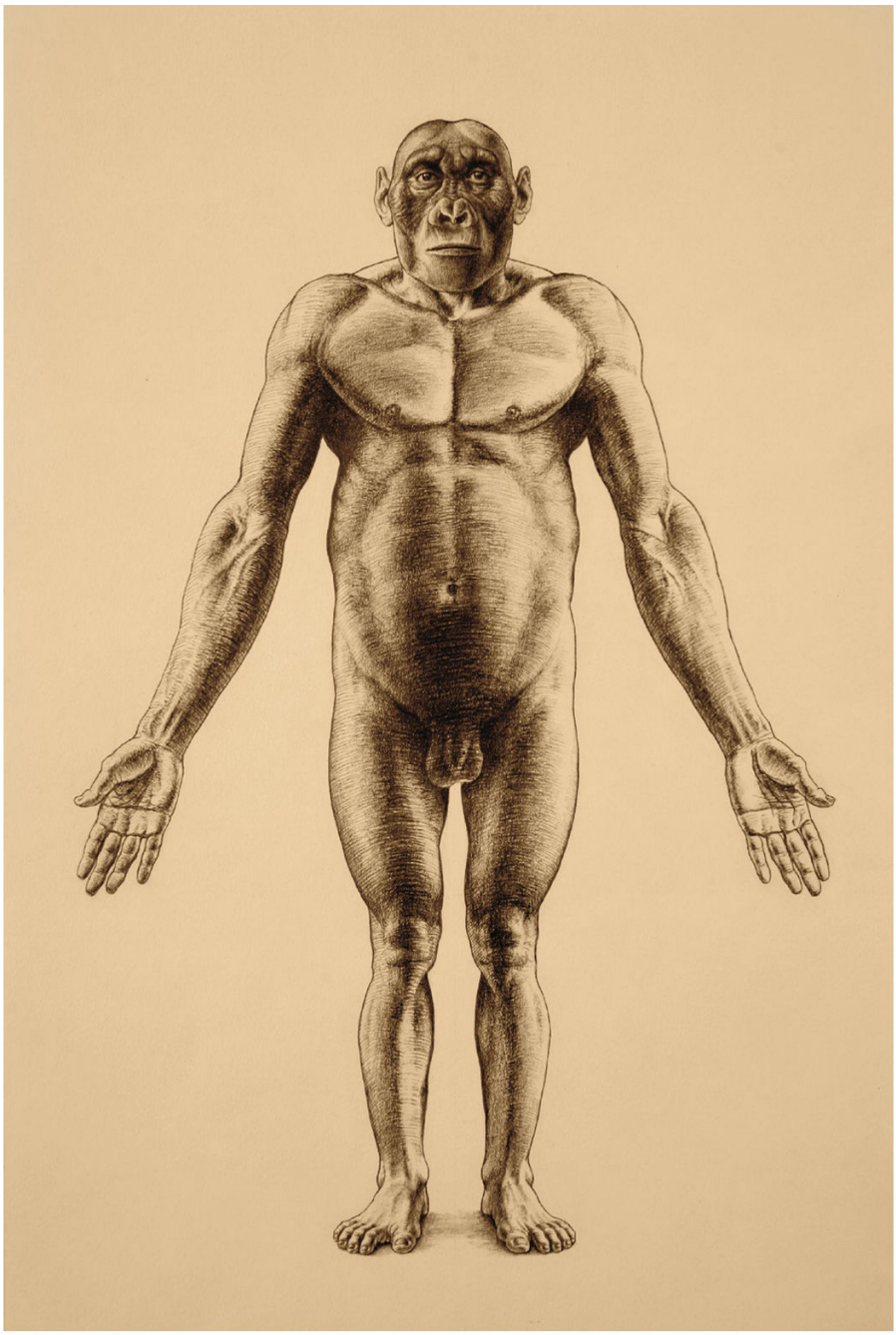
Above:
Australopithecus africanus female skeleton and body outlines. Graphite drawings Xerox-transferred onto acrylic-washed board. With pen and ink.

Right:
Australopithecus africanus male reconstructed skeleton with selected musculature. Pen and ink on acrylic-washed board.

Opposite:
Australopithecus africanus male. Red chalk on board.





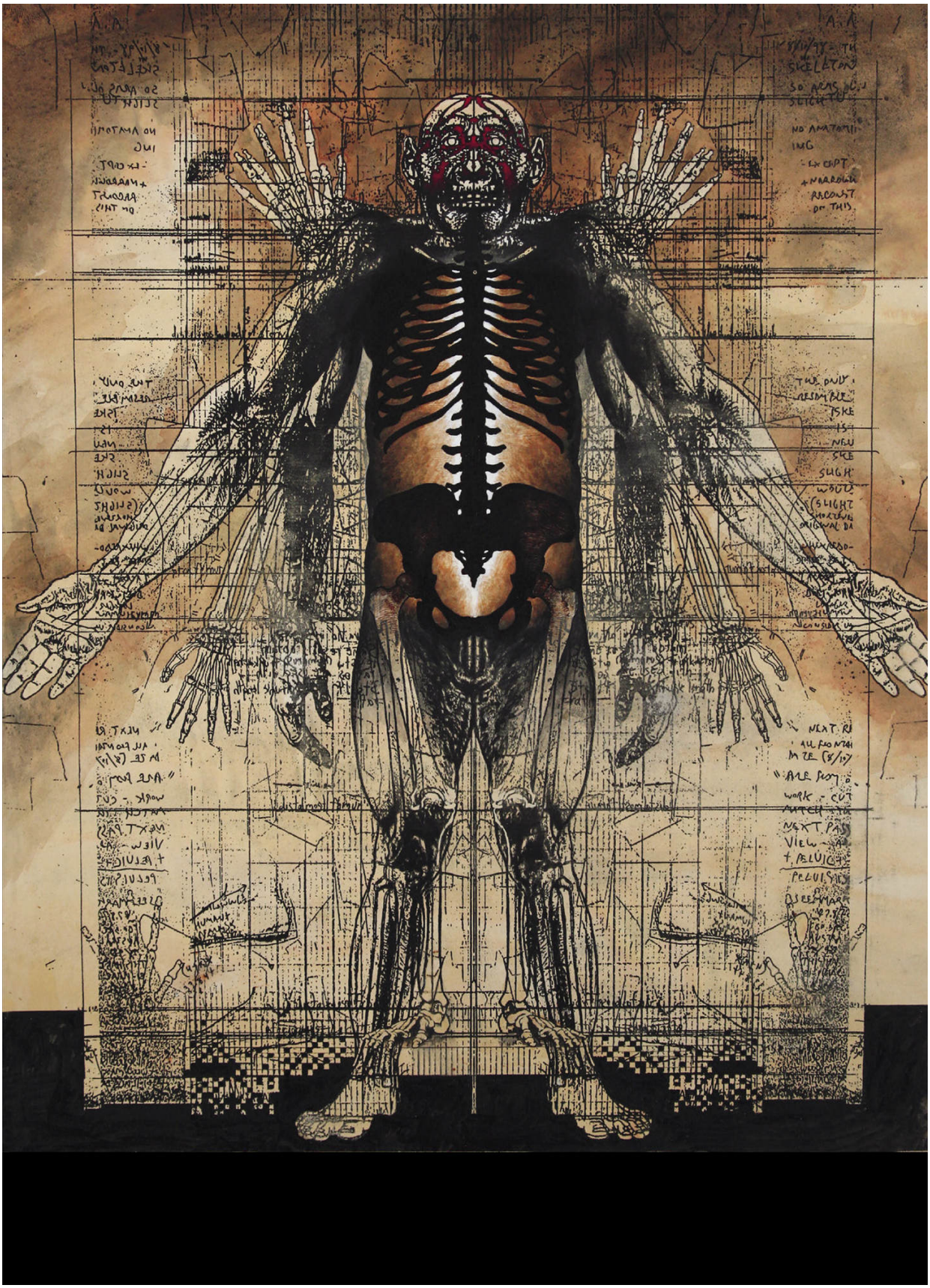


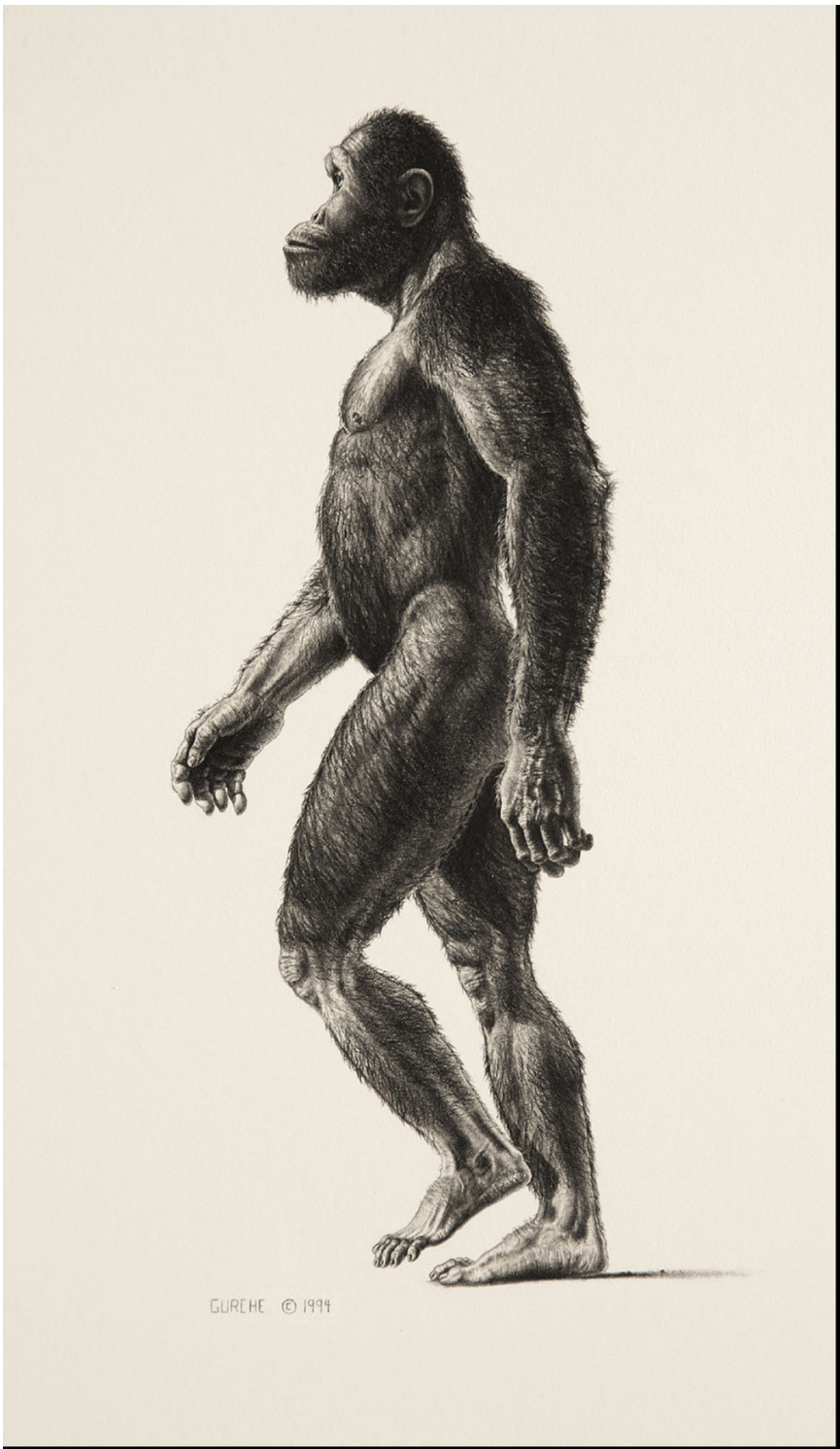
Australopithecus africanus male figure. Graphite on board, digitally colored.

Opposite:
Australopithecus africanus male. Graphite drawings, superimposed and digitally colored.

Australopithecus africanus female. Ink and acrylic.

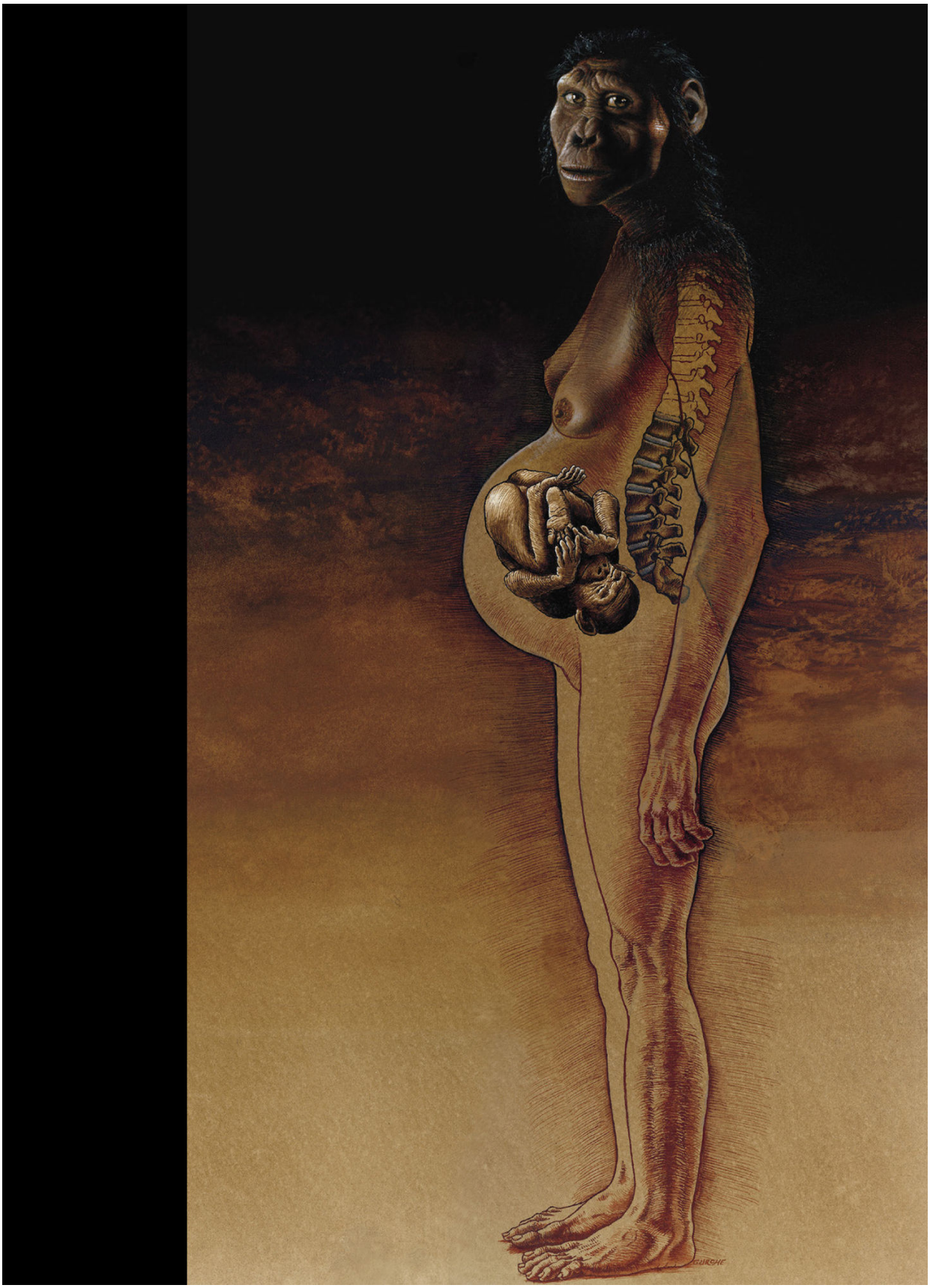
Opposite:
Australopithecus africanus male. Graphite drawings Xerox-transferred onto board, with acrylic washes.

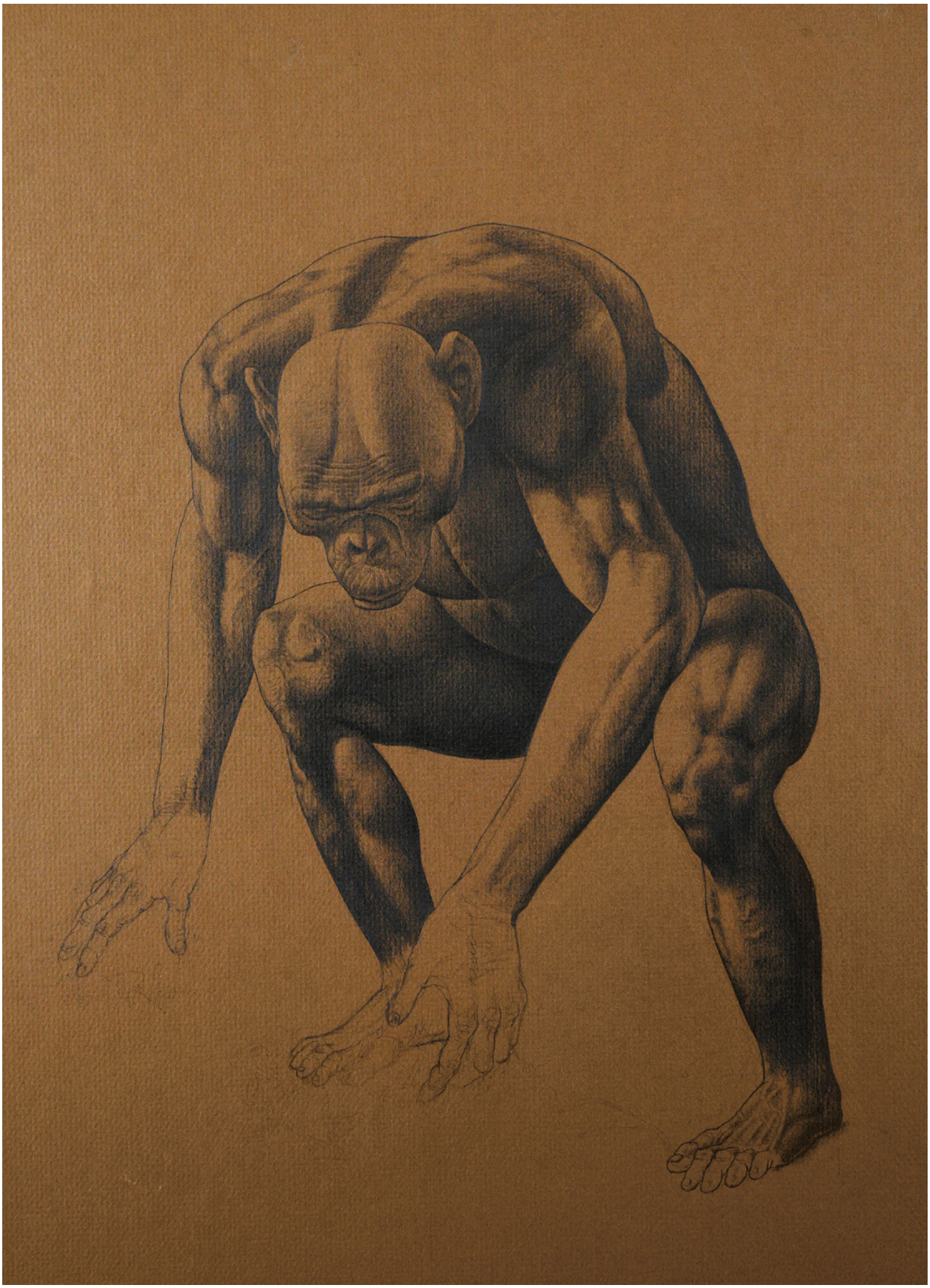




Australopithecus africanus male figure walking. Graphite on board.

Opposite:
Australopithecus africanus, pregnant female figure, with lumbar vertebrae visible. Pen and ink with acrylic on board.



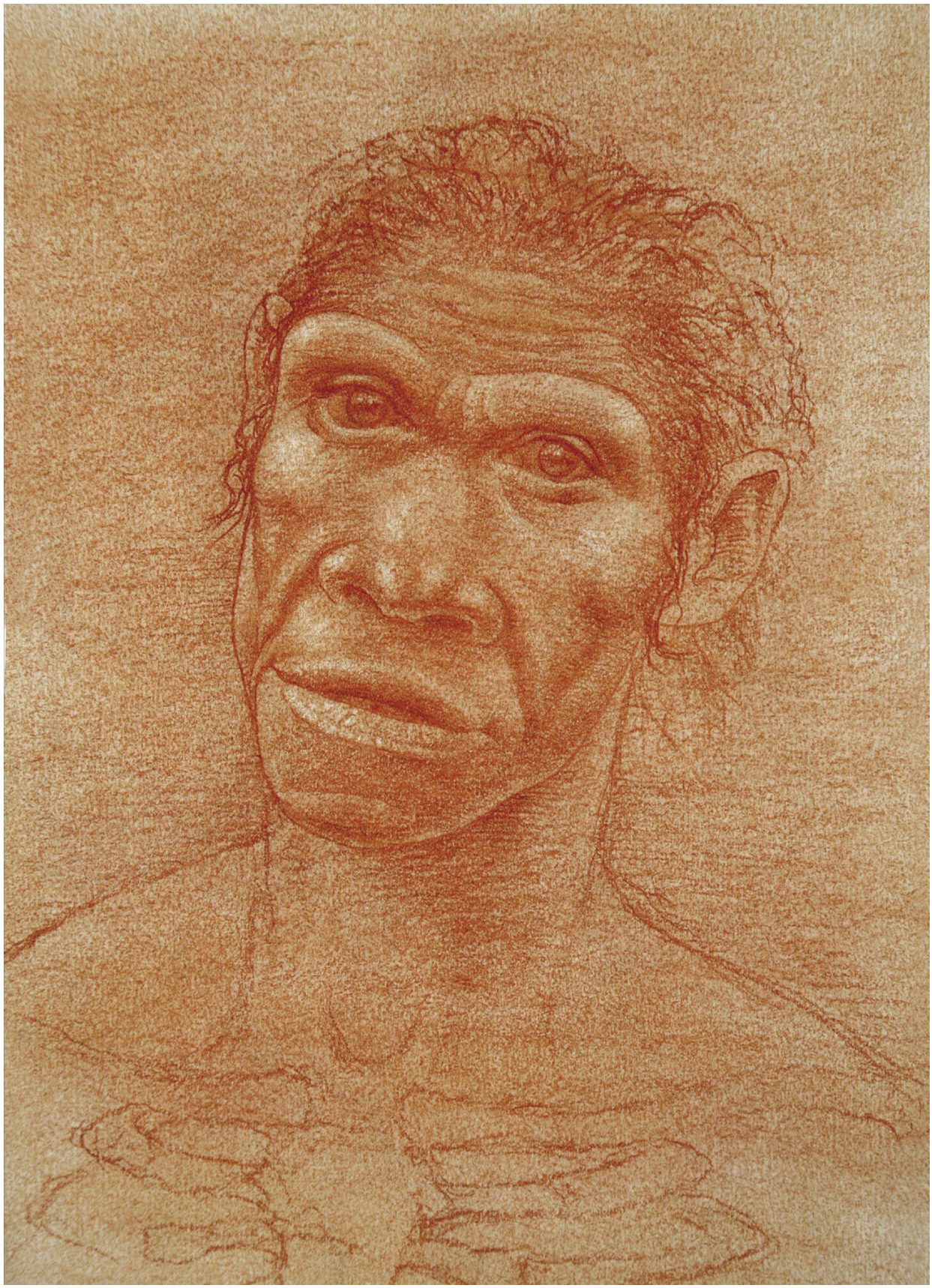


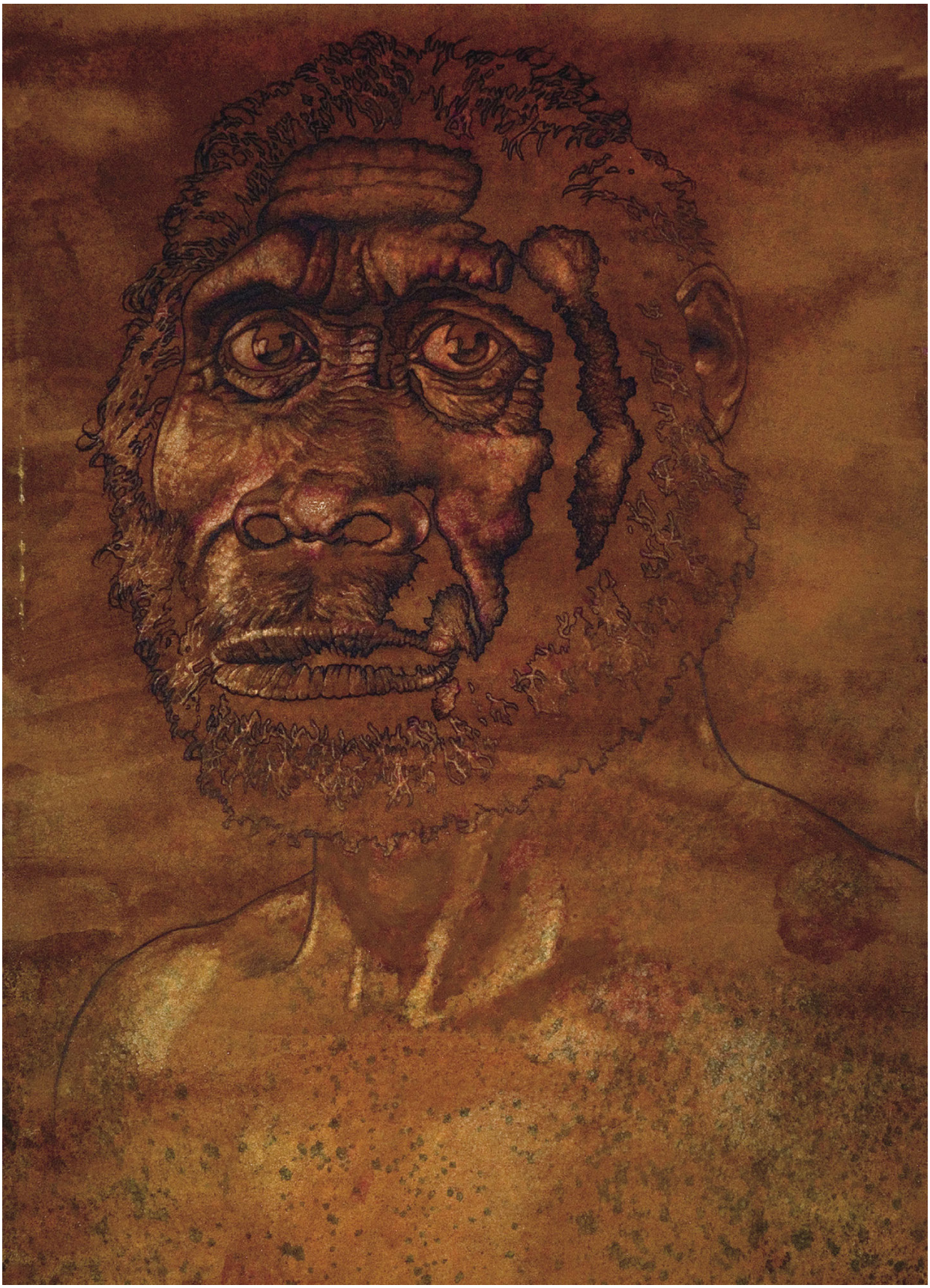
Australopithecus africanus male. Graphite on acrylic-washed board.

Opposite:
Australopithecus africanus male. Graphite on colored paper.

Rick Potts

3 ARCHAIC *HOMO*





Previous page:
Homo erectus female figure.
Red chalk on paper.

Opposite:
Homo rudolfensis male figure.
Black chalk and watercolor.

Fossil remains of our ancestors are like memories, fragments both colorful and dark as if from dreams. They can leave vague impressions or stun us with joy or foreboding. We who study fossilized bones seek to make sense of them, struggling with the fragments to describe, measure, and analyze in the belief that our scientific efforts will somehow reveal the most important things to be learned about our extinct cousins and ancestors. Armed with analytical techniques, we gain insights into how these extinct relatives were unique, how they moved, chewed their food, and managed against odds to extend their genetic heritage from one time to the next. Of course, the story is told not by the original owners of the bones but by us. It is a tale from our living viewpoint.

This pull of the present as we seek to understand the past is most powerful as we inspect the fossils of our own evolutionary group, the genus *Homo*. These particular bones—pieces of braincase and brow, finger and face, tibia and toe—look enough like us that, surely, they belong in the main narrative, with implications for who we humans are today. But, in fact, these wisps from the past are difficult to understand on their own terms, as hard as we may seek an accurate narrative in the present about *their* lives. The past is indeed an unfamiliar place, and this place is compelling for those drawn to the unknown.

We do have hints, of course. The bottom of a dust-riddled hillside at a Kenyan site called Lainyamok was where I first felt the thrill of exhuming a fossil hominin bone. I called it "cigar man" because this battered shaft of a femur, unassignable to species, resembled a thick stogie. By itself, this fossil cylinder could reveal little—except for a perilous story suggested by where it was found: within a 334,000-year-old pocket of gnawed zebra and antelope bones bearing the telltale clues that a hyena relished the taste of four- and two-legged captives dragged to its den. The ends of this hominin thigh had been chewed off. No blood, and all strings of sinew and nerves had decayed away. It was just this piece of bone that had lain in the

Homo habilis female figure. Red and black chalk on paper.

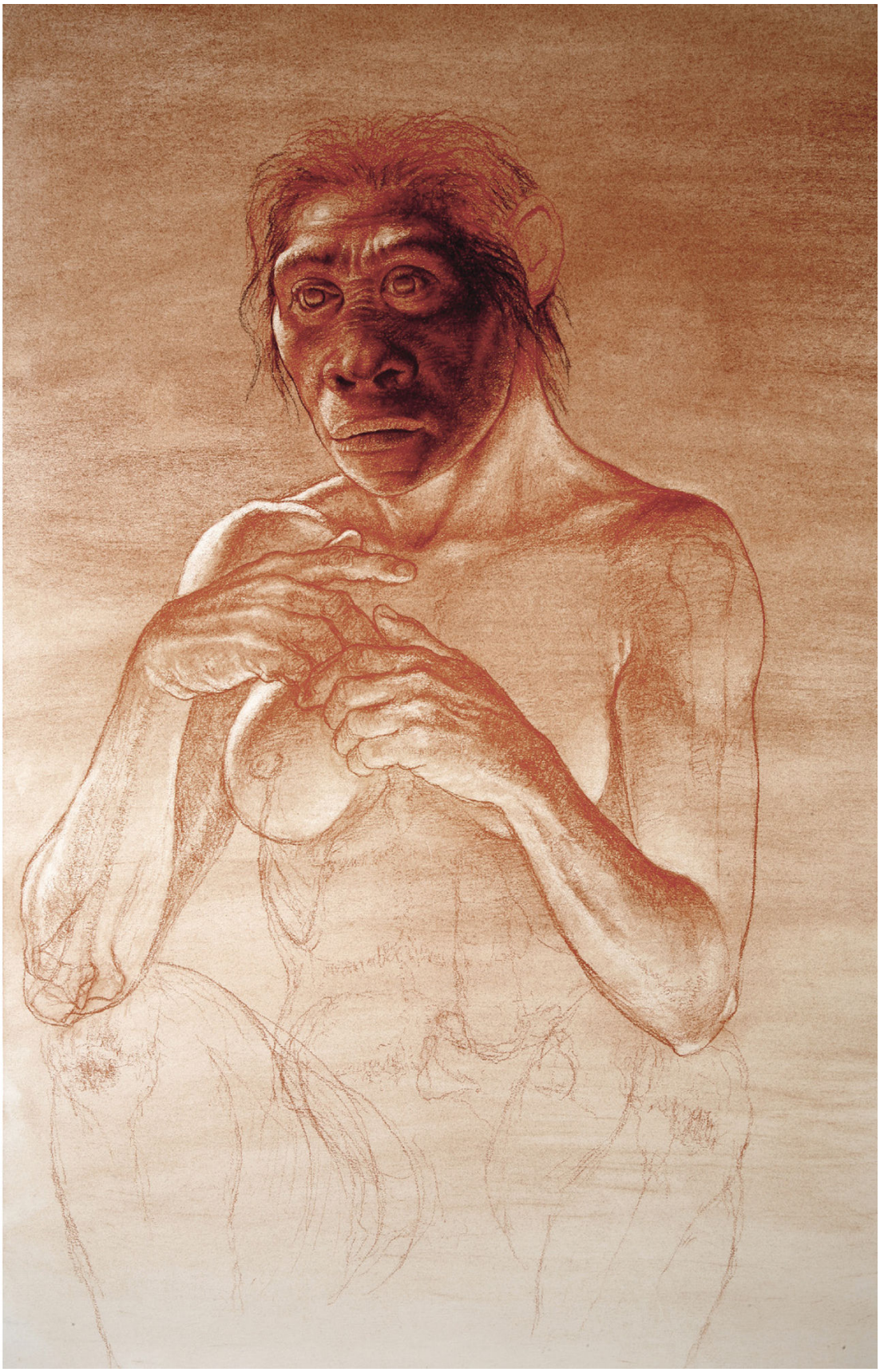
ground for hundreds of thousands of years. Yet the thigh had an owner, surely a sentient being who had known things, cried, probably felt love for others. And who had perhaps died wide-eyed in the menacing grasp of an innocent killer.

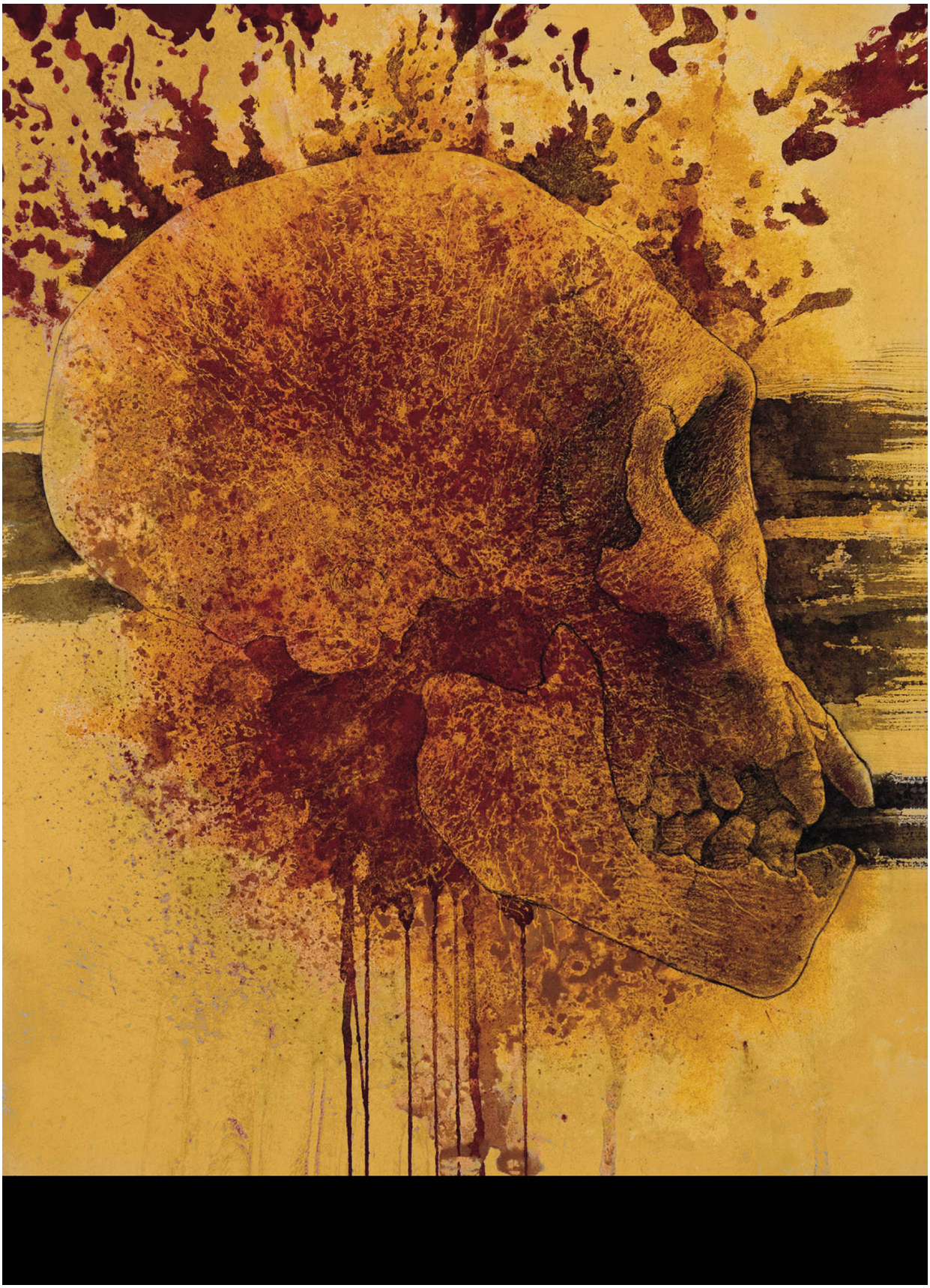
It's all too easy to write drama. Yet to be satisfied with thinking of the fossils as mere bones is to lose the reality of their owners' breathing and striving.

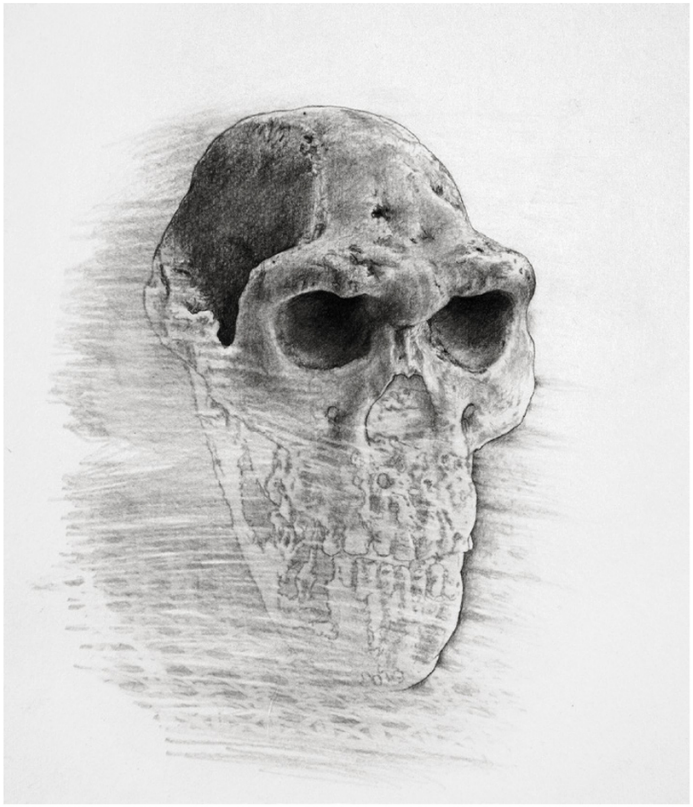
Who is fossil *Homo*? It is the grouping of extinct species most closely related to ourselves and whose evolutionary history is written with headlines that define our own kind: brain enlargement, dependence on manufactured tools, prolonged maturation, and, eventually, complex symbolic behavior and diversified cultures spread across the planet. We, of course, are the survivor of this efflorescence of species—seven to eleven (and counting) distinct lineages are recognized by most researchers. The varied fates of species in our evolutionary group are something of a drama: origins, extinctions, movements, and adjustments to varying environments and diverse habitats as the geography of *Homo* expanded.

The origin of *Homo* is one of the great challenges in the study of human evolution. According to current finds, our genus began its evolutionary journey a little after three million years ago. Smaller molars and other finer aspects of the teeth and jaw mark the subtle separation from the australopiths, perhaps indicating that a new type of diet gave the initial nudge to our ancestral lineage. The extent to which stone toolmaking, reduced tooth size, and brain expansion were interdependent—and whether such a package of adaptations played a defining role in the origin of *Homo*—have yet to be determined. The fossils offer only rare, fragmented glimpses of these hominins over hundreds of thousands of years, and only about two million years ago does brain enlargement, a defining development of our lineage, become sufficiently apparent in fossil skulls to confirm that *Homo* had gained a foothold in the African biota. Whether by coincidence of preservation or an actual flourishing of adaptive possibilities, the lineages we name *Homo rudolfensis* (page 120), *Homo habilis* (page 123), and *Homo erectus* (pages 119 and 142) appear in the fossil record roughly two million years ago.

In any drama, evolutionary or Shakespearean, the distinctive qualities of the cast of characters are important to figure out. If somehow you mistake Rosencrantz for Hamlet, you will become hopelessly baffled. (And how can we really know Yorick? We get to see only his skull.) Although species of early *Homo* overlapped in body, brain, and tooth size, all typically had larger brains and bodies than *Australopithecus*. Nonetheless, early *Homo* is perplexing. An encephalized brain and small teeth distinguish *Homo habilis*, yet these qualities were coupled with a small australopith-size body. Larger teeth, a bigger braincase, and a flat, squarish lower face describe *Homo rudolfensis*. Fossils of the oldest *Homo erectus* possess a rounder lower face, small teeth, and a somewhat smoother braincase that overlapped in size with the braincases of contemporaneous lineages. *Homo erectus* had also evolved humanlike body proportions, with elongated legs relative to the torso (page 140). An increase in the length of the legs in any mammal species signals a greater range of mobility, a creature capable of covering longer distances. So it makes sense that *Homo erectus*







Homo erectus. Skull 5 from Dmanisi, Republic of Georgia. Graphite on paper.

Opposite:
Homo erectus. Skull 3 from Dmanisi, Republic of Georgia. Graphite, pen and ink, acrylic, and powdered pigments on board.

also ventured into regions beyond Africa and spread as far as eastern Asia by 1.7 million years ago.

While these descriptions of the dramatis personae seem fairly clear, there is much ado about the best known, *Homo erectus*. A wondrous diversity of braincase shapes discovered at Dmanisi in the Republic of Georgia—one of the oldest known *Homo erectus* sites—is thought by some of my colleagues to imply that *all* fossils of early *Homo* belong to a single, variable lineage of *Homo erectus*. But how's this for contrast: Others think that the same Dmanisi finds offer as many as three distinct species that had the misfortune to die in an area no larger than a modest theater stage. What a piece of work is early *Homo*!

Homo erectus has often been deemed the most prominent link between the australopiths and our own species. Indeed, *Homo erectus* used to be portrayed as one giant leap for mankind, defined not only by an enlarged brain and long legs

Homo erectus juvenile male figure, with *Homo naledi* adult male figure. Pen and ink, acrylic, and graphite on board.

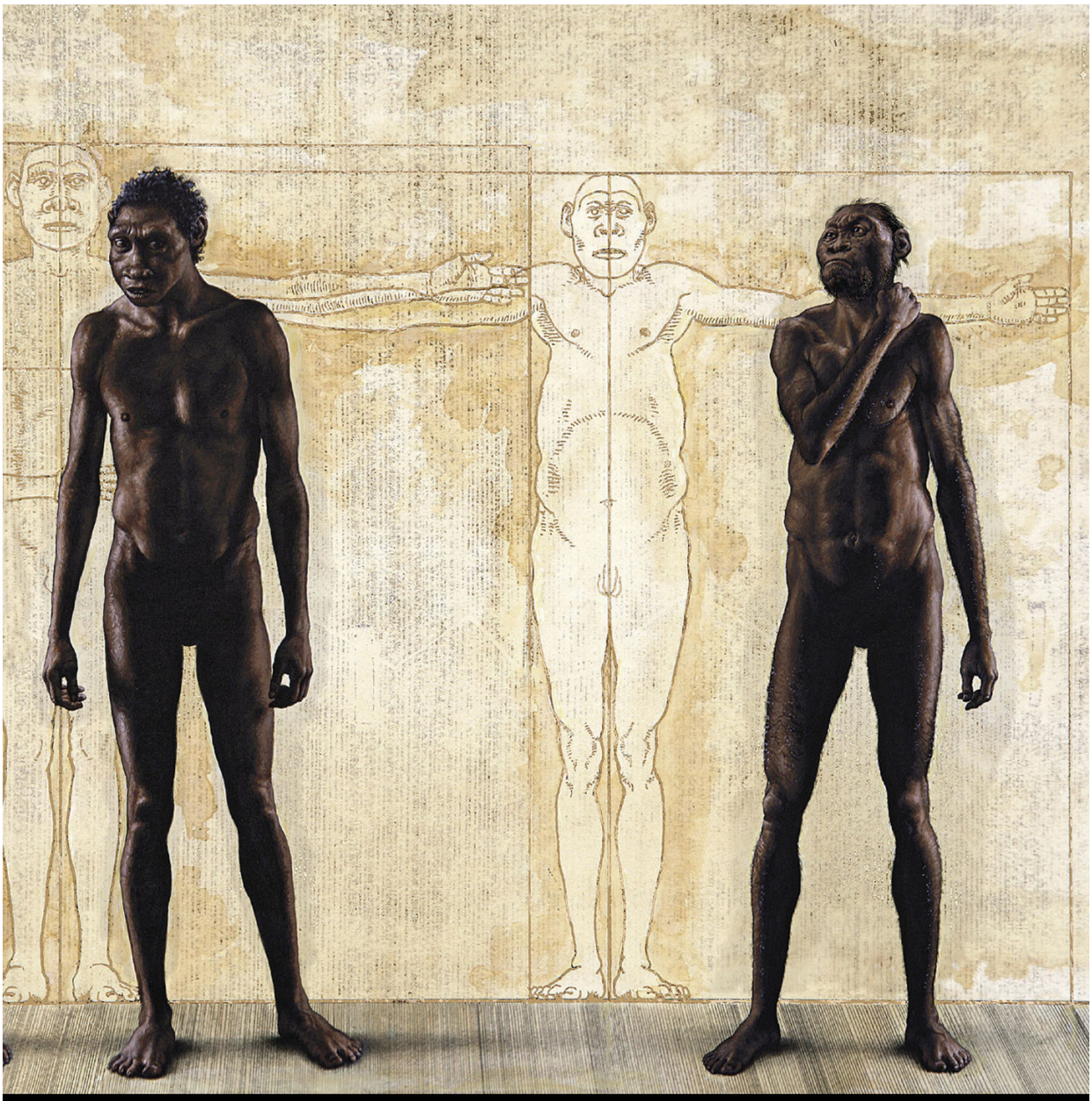
but also by a broad diet, prolonged maturation, and the ability to craft sophisticated handaxes, control fire, and build shelters focused at a home base—activities similar to those of extant hunter-gatherers. It turns out, however, that *Homo erectus* is far more complicated, and fascinating, than conveyed by such wishful thinking. Instead, these distinctly human traits evolved individually and at different times in the past rather than as a package in one decisive span.

Maturation of the body is an intriguing example. Although the body proportions of early *Homo erectus* looked like ours, the similarity was the result of a far shorter period of growth. The timing of tooth eruption provides the key insight. The cheek teeth we call "twelve-year-old molars" because of their typical age of eruption in kids emerged from the gum at roughly eight years of age in *Homo erectus*, which is more in line with the pace of growth in our great ape kin. *Homo sapiens*, by contrast, lives life in the slow lane, a fact that holds immense consequences for the character of our species. Prolonged growth throughout childhood, which is a consequence of the enormous energy channeled toward brain growth over the first six years of our lives, allows children time to play, learn, and accumulate a body of social and survival experiences. The trials and tribulations of parental care—instructing, rewarding, all the pain and worry—are required by the many years it took for each of us to fumble and probe our surroundings when we were kids and teenagers. We wouldn't live in the cultural manner of our species without this prolonged period of growth. Early *Homo erectus* didn't have it; sometime over the past one million years, a shift in the timing of human development came about, recorded in the teeth of our species and the Neanderthals.

In my view, the ways of life of the extinct lineages of *Homo* are, ultimately, mysterious. Whenever possible, we try to see ourselves in their story. The things they left behind, however, are less familiar than we might surmise. Beginning with African *Homo erectus* and continuing to later *Homo*, we find ovoid-shaped stone handaxes and other large cutting tools entombed in layer upon layer of sediment for roughly 1.5 million years. By today's standards of impatient invention, it seems absurd that handaxes persisted as the dominant technology over such a long era. The tools are evidence of a kind of cultural living unknown in the present.

The ability to make the largest of the large cutting tools speaks to a further distinction we can assign to archaic *Homo*: the sheer power of their bodies, evident in strong, robust bones. The slender arms, legs, and hips typical of recent humans developed with the adoption of a less rigorous life not much more than 12,000 years ago. Even the most relentless gym rats cannot build bones as thick and strong as those of earlier versions of *Homo*.

Despite such findings, we still tend to assume that species allowed membership in our own genus must have been reasonable facsimiles of ourselves. However, the unexpected anatomies of fossil species such as *Homo floresiensis* and *Homo naledi* provide further evidence to the contrary. The former, best known from an adult skeleton cutely nicknamed the "hobbit," stood only three feet, three inches tall



and weighed perhaps sixty-four pounds. Its brain resided in the far low end of the range of known variation back to *Australopithecus* and even *Sahelanthropus*.

How did *this* one get to join our taxonomic club? Despite the species' size, the morphology of its skull is that of card-carrying *Homo*. Its lineage is possibly derived from a *Homo erectus* population that inhabited southeastern Asia, probably Java in Indonesia, when that island was connected to the mainland. Some small founding set of individuals then freakishly traversed nearly four hundred miles of mostly open water to the island of Flores about one million years ago. From that time until its extinction only 50,000 years ago, *Homo floresiensis* evolved as a peculiar, isolated experiment in being human, cunning enough to have endured on the meager resources small islands offer in times of scarcity.

Given our expectations of archaic *Homo*, the species *Homo naledi* wins the oddball prize for its mix of progressive and primitive features all in one skeleton (page 127). More than fifteen hundred fossils of more than fifteen individuals of this species were recovered deep in a South African cave. With a small brain, curving fingers, and flaring pelvis that seem better placed in *Australopithecus,* but with teeth, jaw, wrist, and foot well stationed in *Homo*, and at a recent age of 236,000 to 335,000 years old, we need no further evidence as to the fluid and surprising nature of the evolutionary process in our genus. To my mind, the mystery of both *Homo naledi* and *Homo floresiensis* conjures up what biologists call "splendid isolation." Instead of participating in an inexorable advance of anatomical form, a population in privacy ends up having the independence to express both current adaptations and latent variations that stick around as a legacy from its deep past. The habitats of Africa are, in fact, described by the naturalist Jonathan Kingdon as "a complex mosaic of landlocked islands—islands which vary from isolated forests in oceans of grassland to lakes in seas of land." It is exactly this peculiar aspect of Pleistocene Africa that made it an astonishingly creative landscape of evolutionary variety. Apparently, *Homo* was not exempt from such splendid isolation. My bet is that beautiful oddities of anatomical form will continue to be discovered.

The evolutionary venture of archaic *Homo* took place as Africa experienced dramatic transitions between wet and dry and as the world withstood rounds of glacial expansion and retreat, coupled with one-hundred-meter shifts in sea level. Although some populations probably confined themselves to relatively stable pockets of environment, revisions of climate and landscape incited other populations to move, split, and come back together, with incipient species originating and vanishing time and again. Such a process of repeated cycles of gene pool seclusion and connection, moved along by instability in the surroundings spanning decades or millennia, is the only way to make sense of prolific recipes of anatomical variation evident in the fossil record over the past one million years.

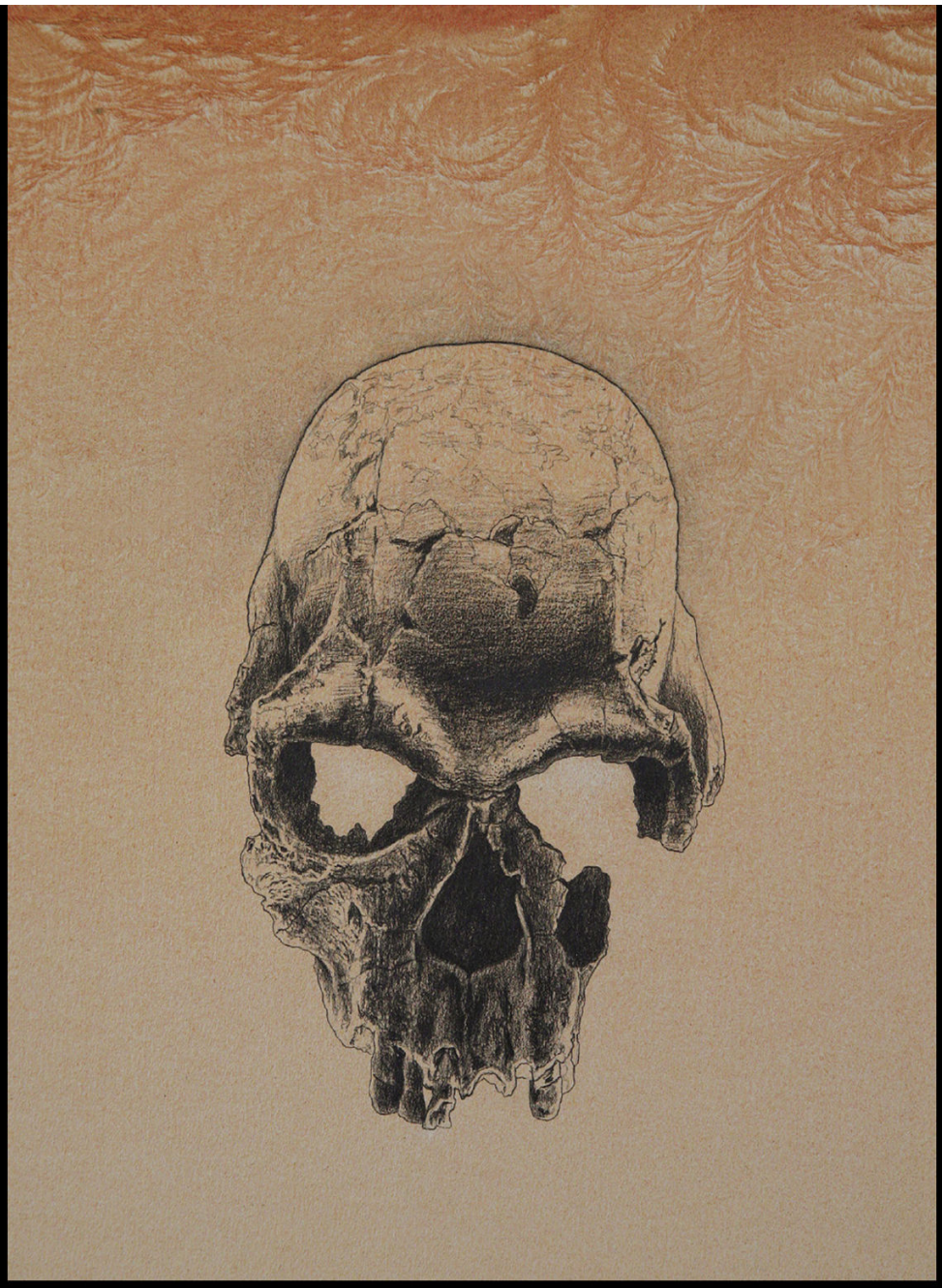
The general category *Homo heidelbergensis* serves to collect many diverse streams of skeletal variation around the time of the divergence of Neanderthals in Europe and our lineage in Africa, which, based on studies of ancient and modern genomes, began as long as 600,000 years ago. By 400,000 years ago, ancient DNA

distinctive to Neanderthals had arisen in western Europe, whereas African fossils show a particular affinity to our species by about 300,000 years ago. Even in the prehistoric remains of *Homo sapiens*, we find that strong brow ridges, angular braincases, and other archaic features were occasionally merged with more advanced traits typical of modern people for at least another 200,000 years after the origin of our lineage. It is, then, perhaps no surprise that human DNA today echoes the fluidity of past genetic input from diverse regions of the world. This fact suggests why it is not always easy to categorize ancient species of *Homo*: The origin of species is neither an instant nor an event but a rambunctious process played out in fits and starts.

As we examine the prehistoric cast of characters, we see that physical adaptations and the acts of ancestors have been transformed over time. Humanity evolved from the struggles and opportunities made possible by those workings of the body that assisted survival. The history of *Homo* has further been shaped by the threats and kindnesses inherent in fierce sociality, the risks and struggles posed by the surroundings, and the perils that lopped off entire branches of our evolutionary tree. To try to comprehend archaic *Homo* requires that we inspect the broken forms that had once been buried in our past. When I first became a dedicated student of paleoanthropology, I was told to be wary of what we think we understand about our origin. What we can know of human evolution, I was told, is similar to what we could know of Leo Tolstoy's massive novel *War and Peace* if we had only ten pages in our possession. From such limited reading, we might well encounter the main characters and have important hints about the overall storyline. But ultimately there is mystery and wonder; significant twists and turns become obvious only with the chance to turn more pages.

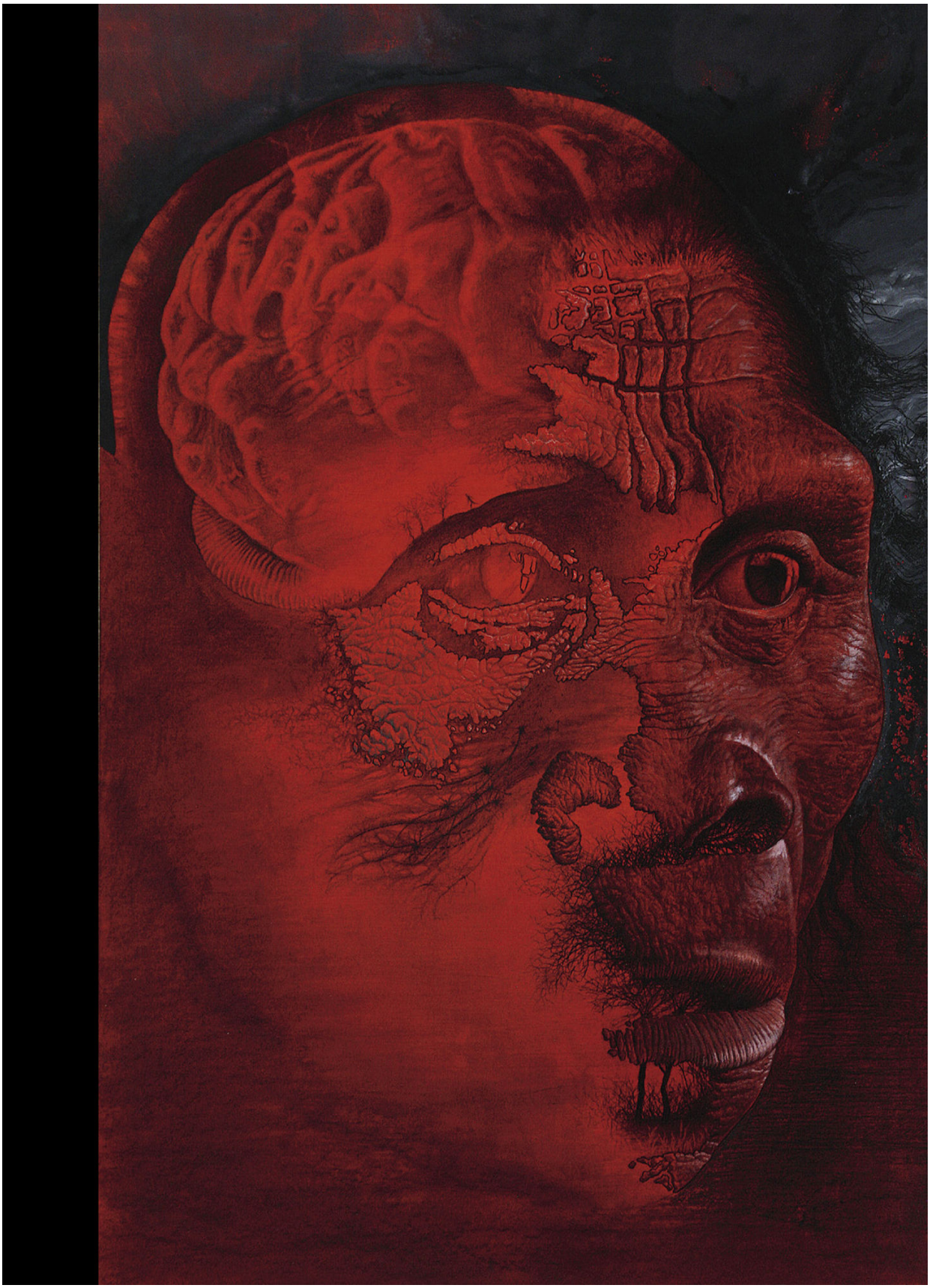
Fossils of our lineage present one of the most compelling puzzles in the pursuit of knowing ourselves: We are part of an immense genealogy, a tree of kinship that is branching and diverse, representing nearly three million years of change. All the past species belonging to the genus *Homo* had some combination of the features that distinguish us today, along with more archaic features. Out of this diversity of lineages, we are the only ones left—*Homo sapiens*, the last biped standing. The ways of life manifested by our cousins and direct ancestors are now gone, which is a matter to contemplate if only because it reflects the fragility of life in our immense journey. To ignore these extinct members of our evolutionary family is to lose a sense of the bridge they provide between us and the rest of nature. They are like ripped and yellowed photographs of distant grandparents found in the farthest dusty corners of our home. We might well feel moved to wonder who they were.

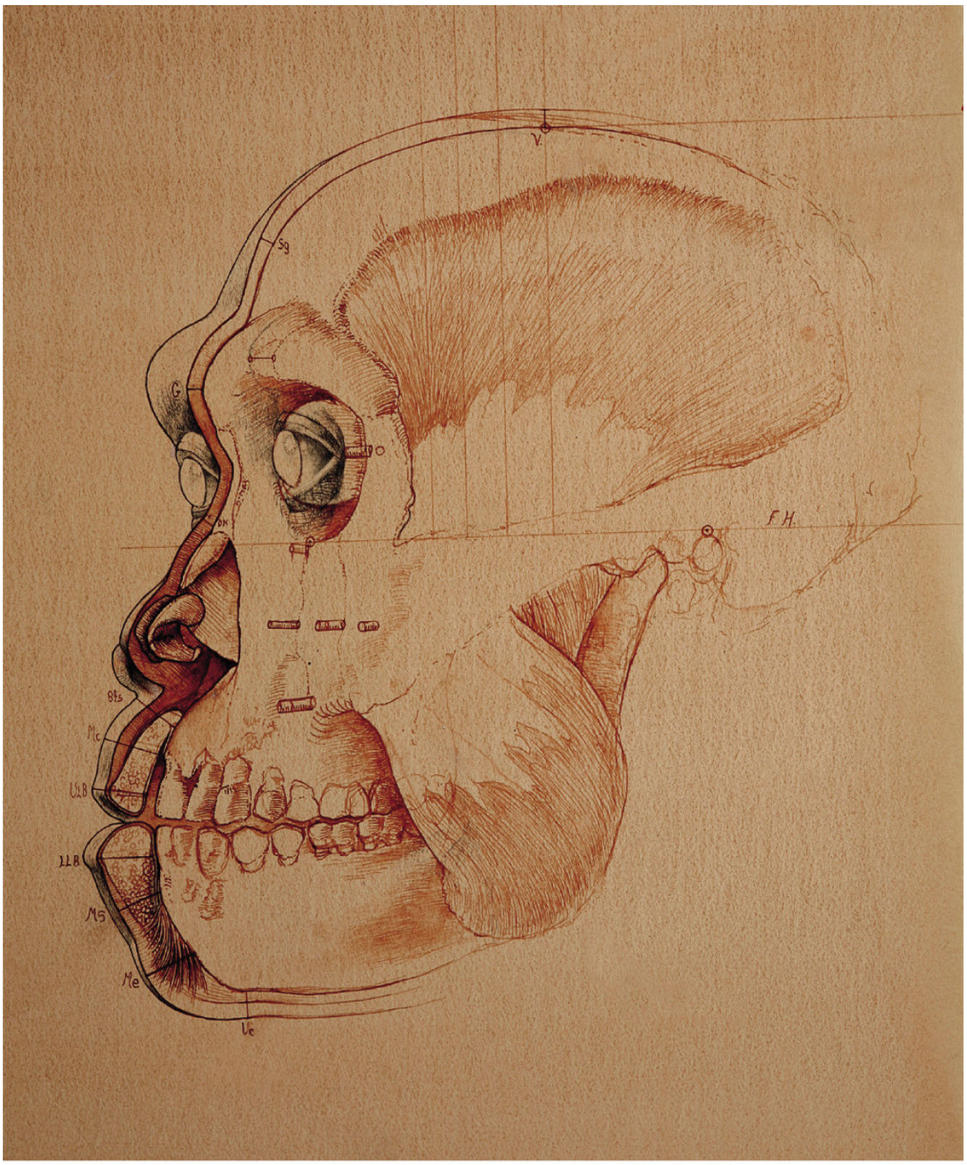
The search, discovery, and analysis of fossils is a difficult, painful urgency for scientists who take on these endeavors. Yet creative, visual art takes us into the realm of actually *seeing* the hard and broken travelers we have brought to the present. Look in the eyes of *Homo erectus*, see the glint of its stare—cunning, compassionate, even curious. The lives of our forebears become personal, and we begin to find something that was once lost.



Homo habilis female skull. Graphite on acrylic-washed and frost-treated board.

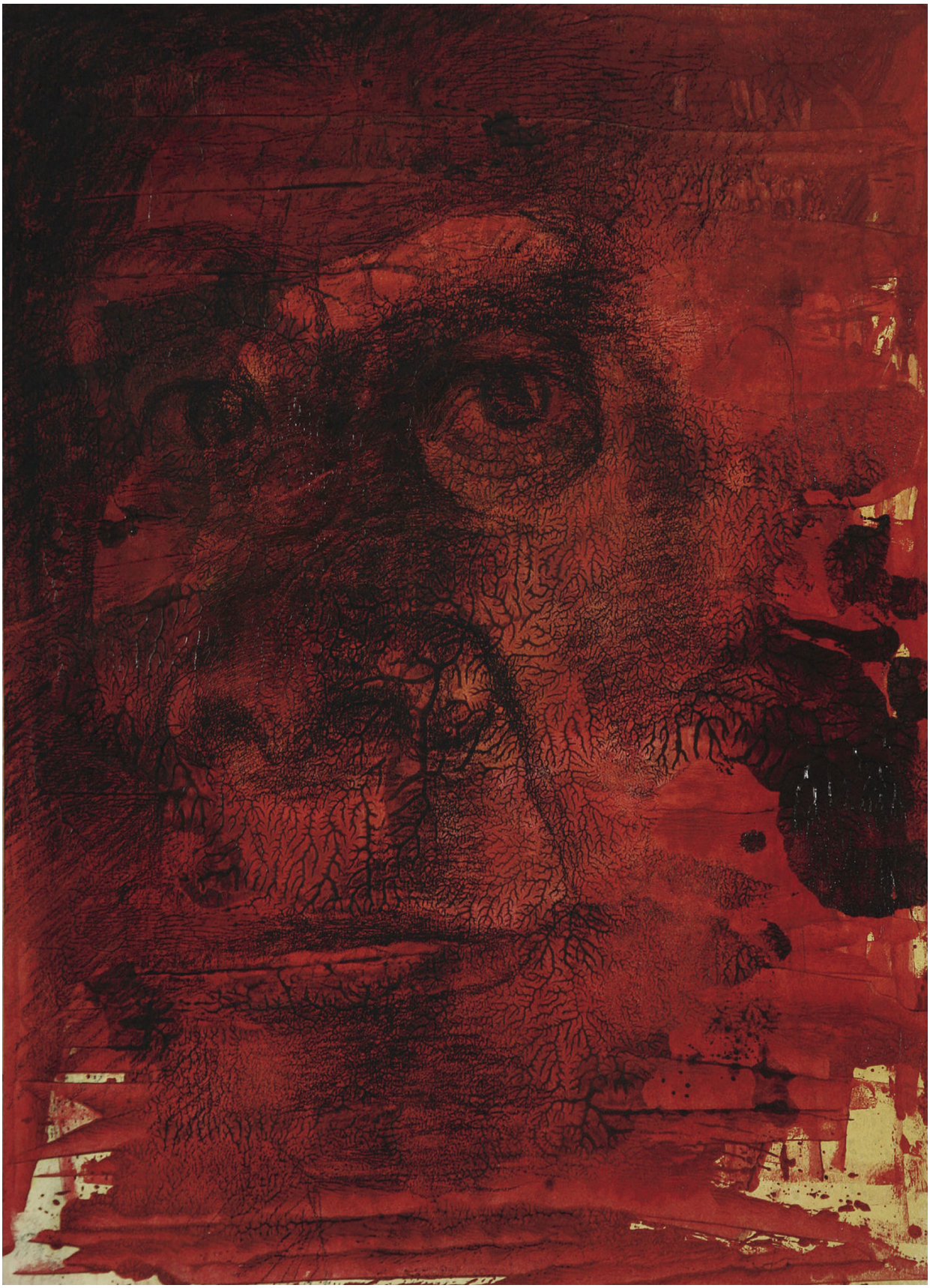
Opposite:
"Dreaming Brain." *Homo habilis* female. Graphite and acrylic on board.





Homo habilis female, deep anatomy of the face. Pen and ink on acrylic-washed board.

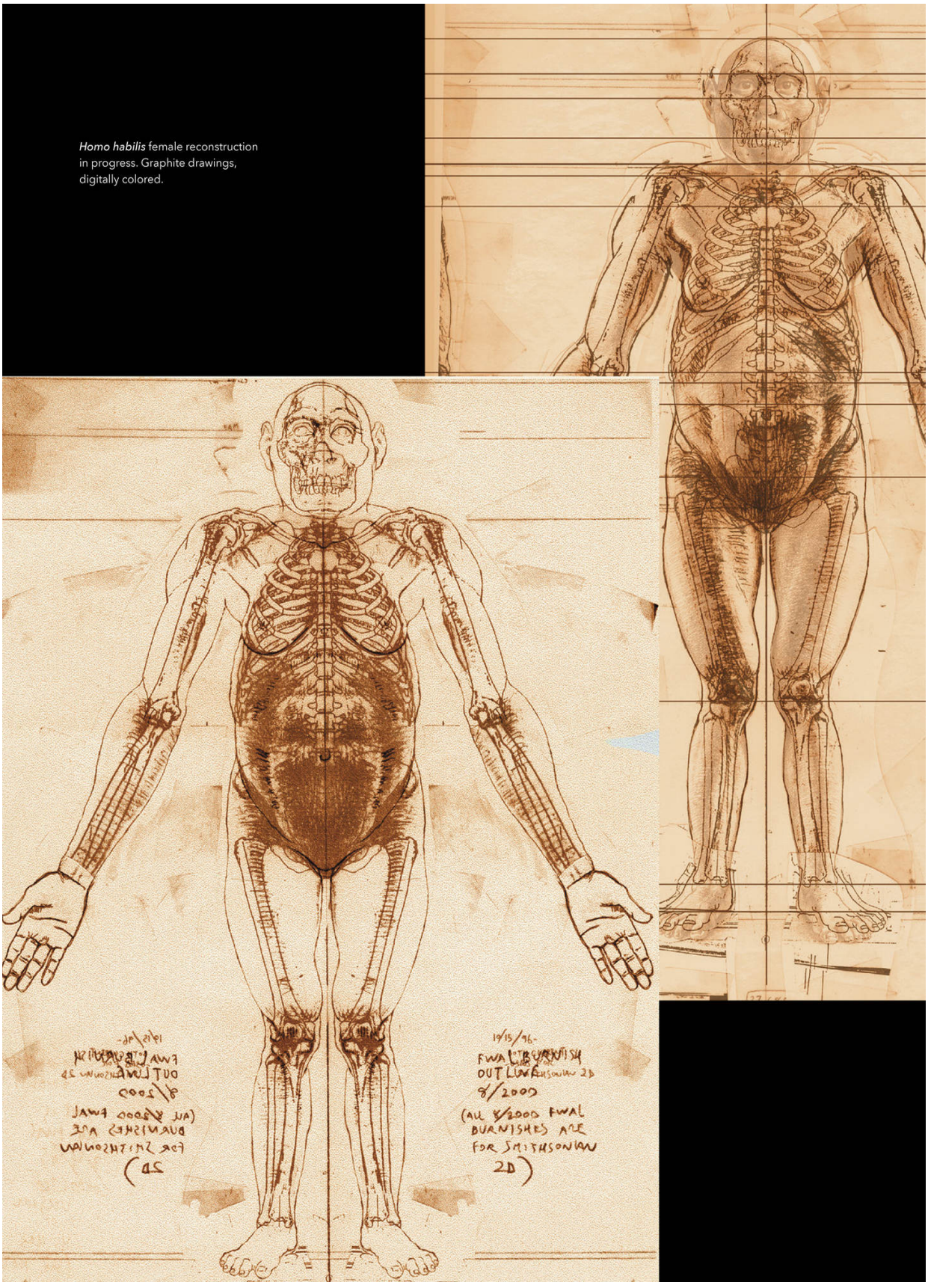
Opposite:
Homo habilis. Black chalk and acrylic on board.

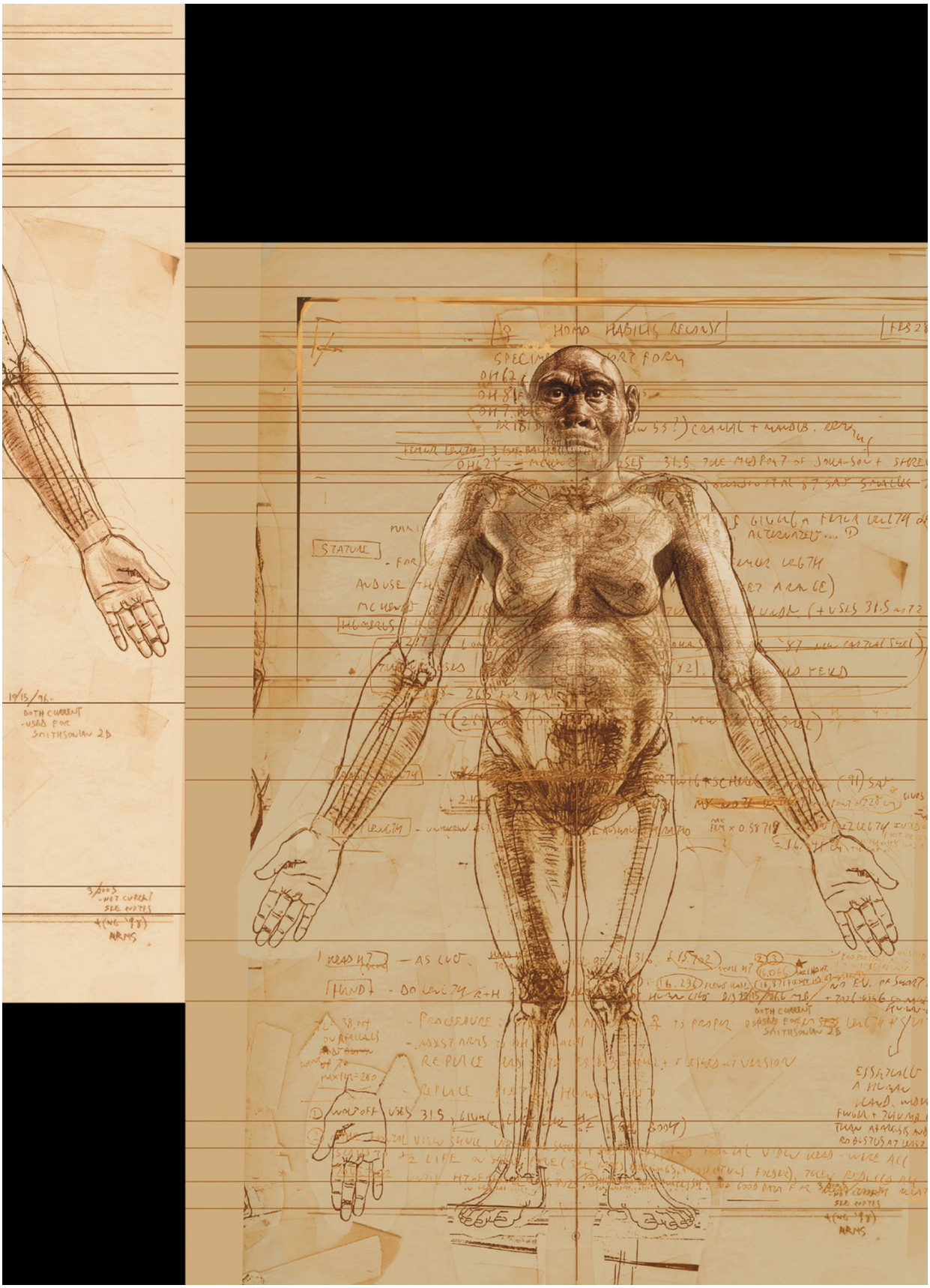


Homo habilis (male?) partial skull. Graphite on paper.

Opposite:
Homo habilis hypothetical male. Pen and ink on colored paper.

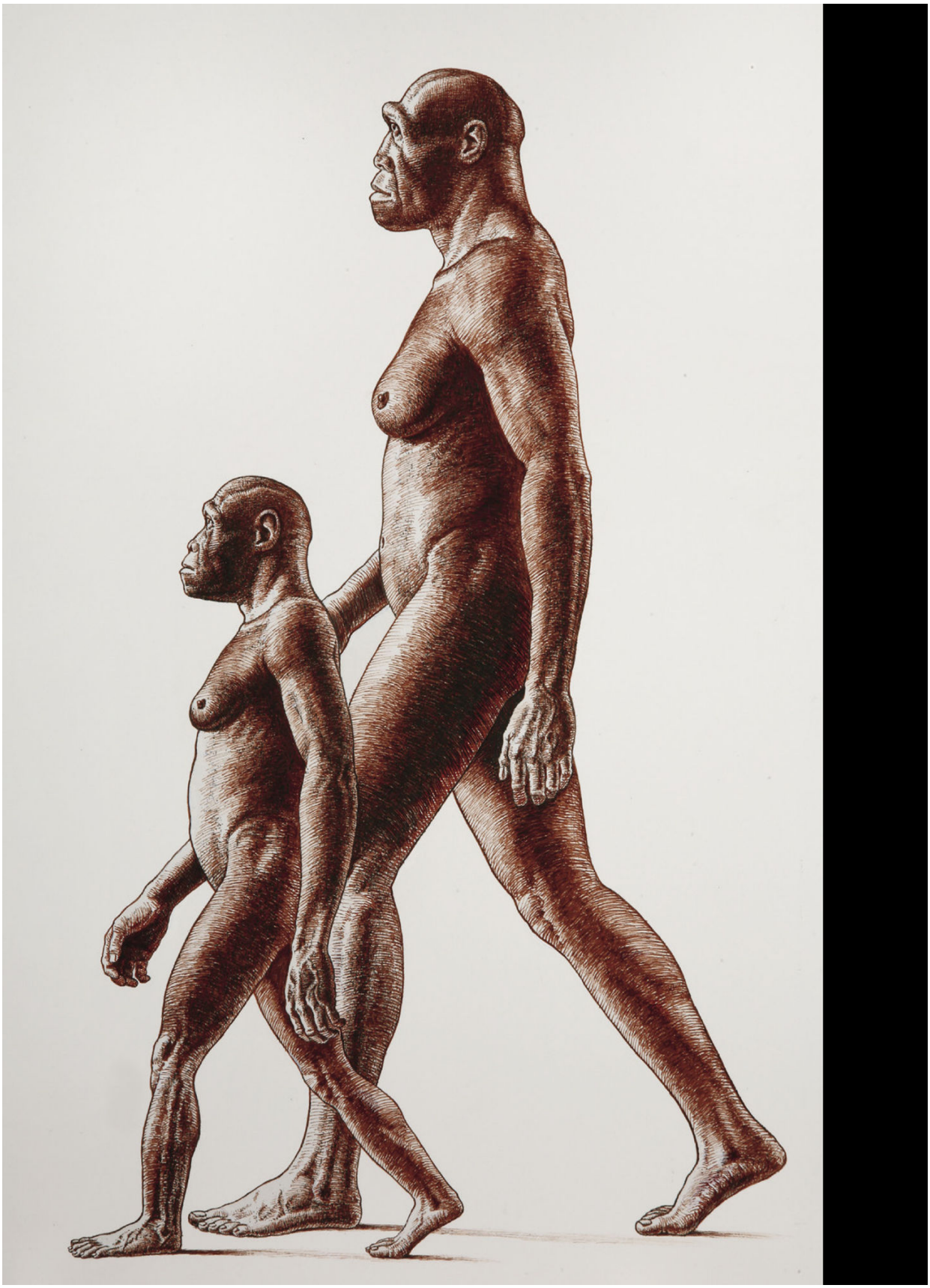
Homo habilis female reconstruction in progress. Graphite drawings, digitally colored.



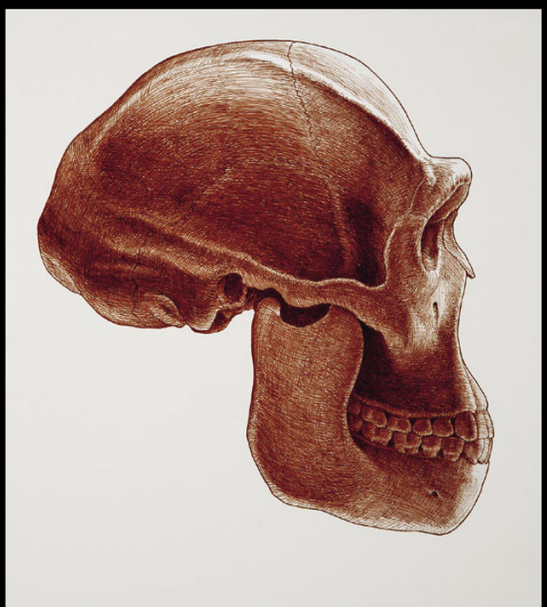

HOMO HABILIS
SPECIMEN
STATURE
HAND
ARMS

Kenyanthropus platyops skull. Graphite on paper.

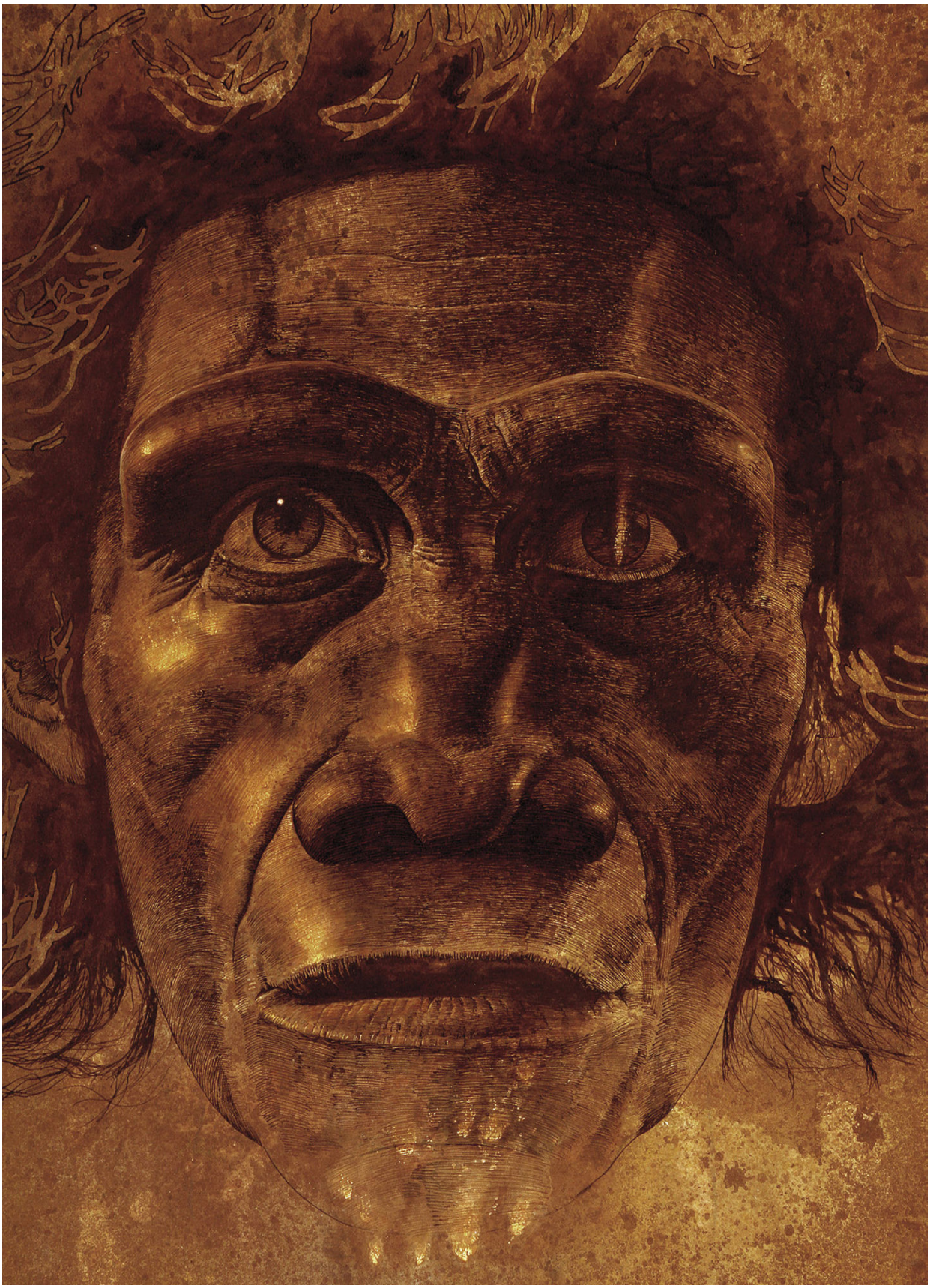
Opposite:
Homo (or *Kenyanthropus*) *rudolfensis* skull. Graphite drawing, giclee printed on acrylic- and sand-washed board, with black chalk added.

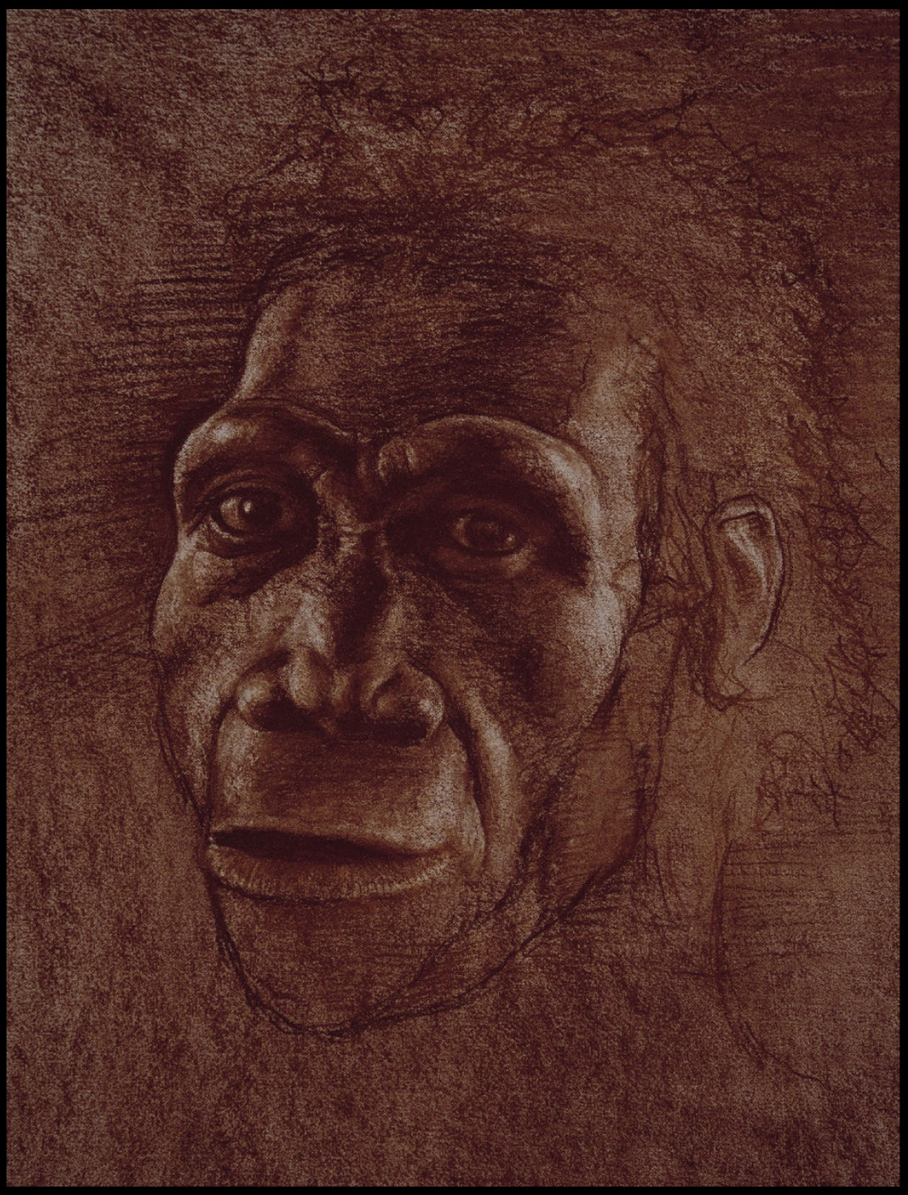


Three views of African *Homo erectus* skull KNM-ER 3733, one with chewing muscles. Pen and ink, with acrylic and digital work.



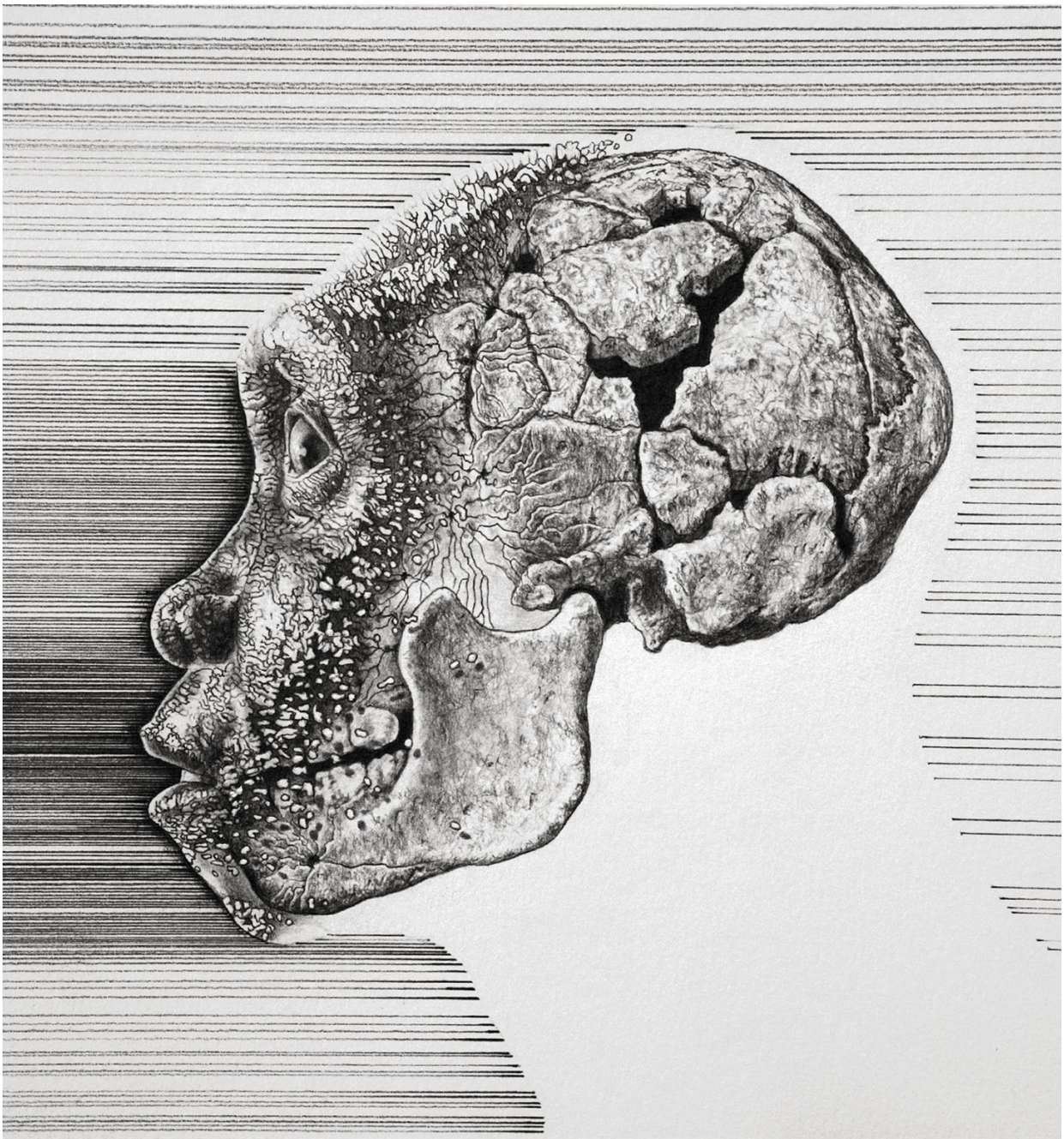
Opposite:
Homo habilis (left) and ***Homo erectus*** female figures walking. Pen and ink on board.





African ***Homo erectus*** female. Red chalk on paper.

Opposite:
African ***Homo erectus*** female. Pen and ink with acrylic highlights and background.



African *Homo erectus* juvenile male ("Nariokotome Boy") skull and face. Graphite on paper.

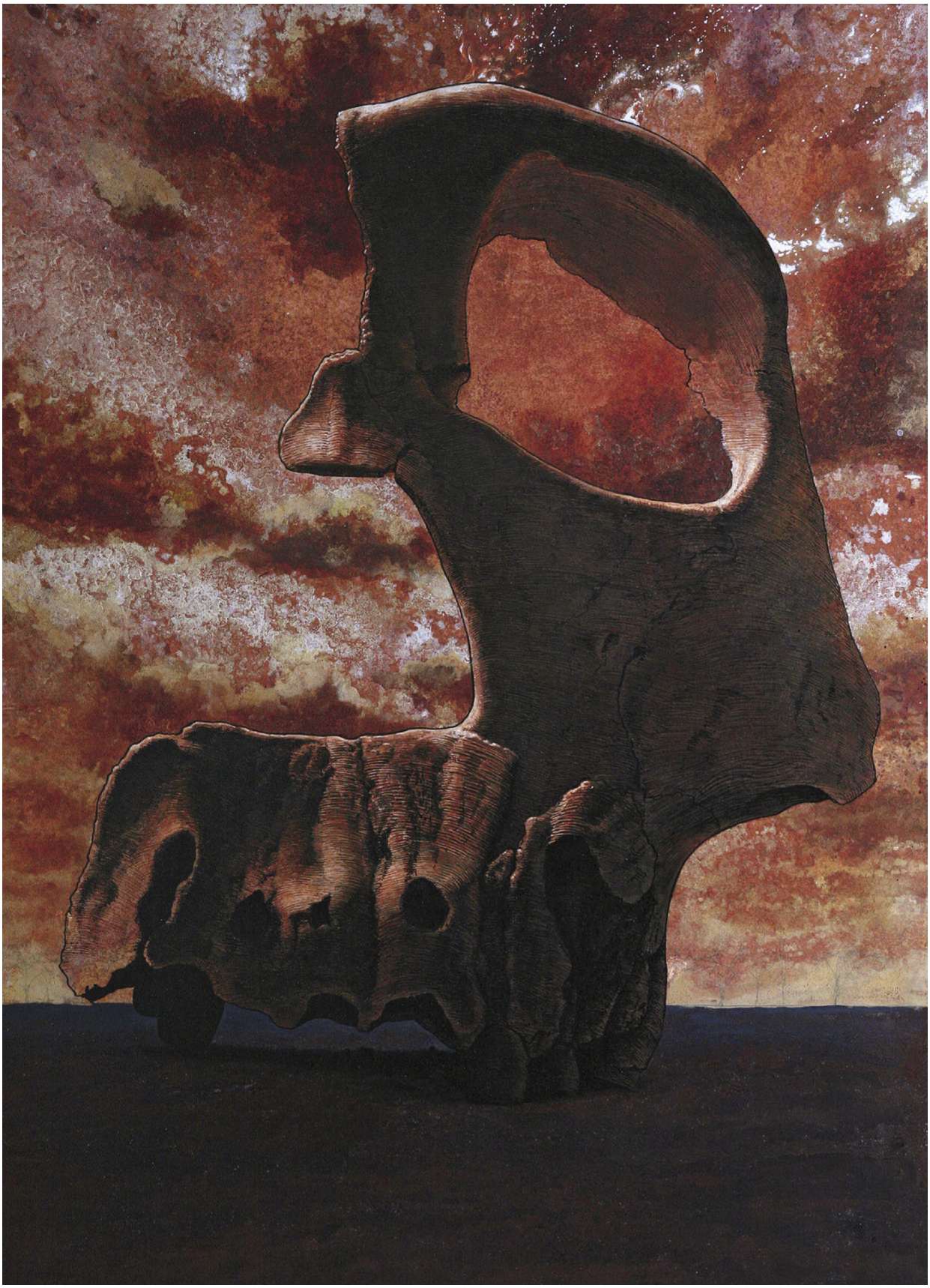
Opposite:
African *Homo erectus* juvenile male ("Nariokotome Boy") skull. Pen and ink with graphite on acrylic-washed board.

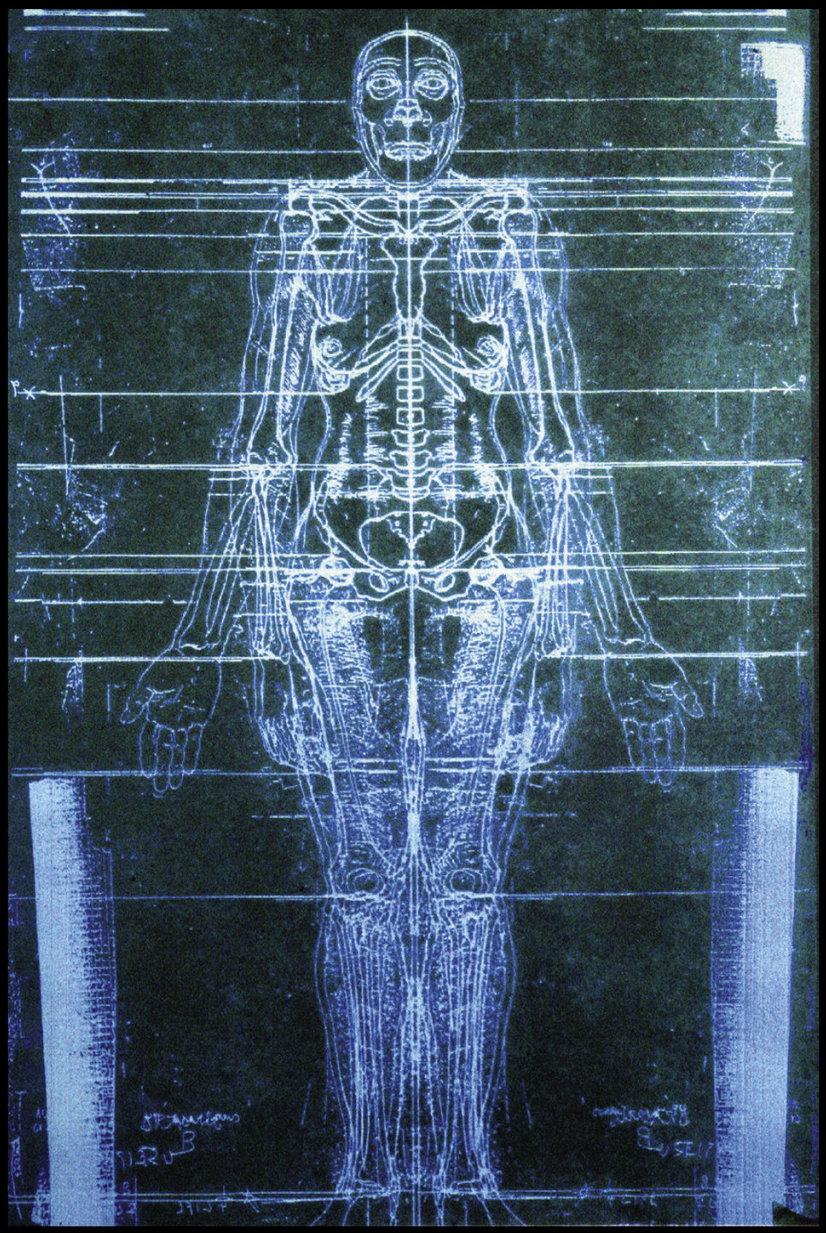
African ***Homo erectus*** female. Graphite on board.

Opposite:
African ***Homo erectus*** juvenile male ("Nariokotome Boy"). Acrylic.

Javan ***Homo erectus*** male skull. Graphite on paper.

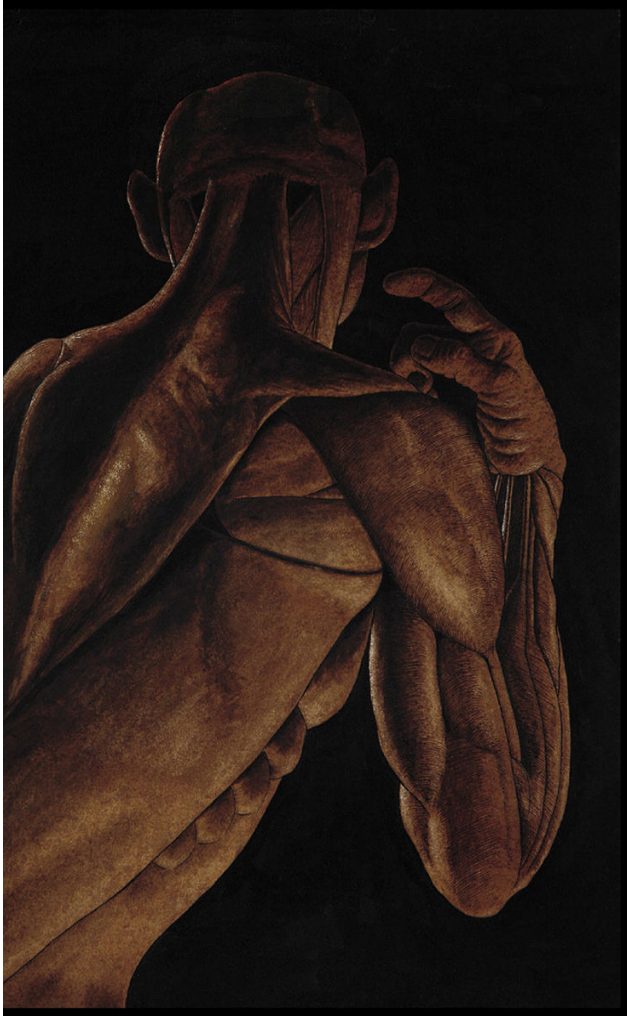
Opposite:
Javan ***Homo erectus*** male. Pen and ink drawing, with Xerox transferred anatomical notes, partially burned, digitally colored and giclee printed, with added ink and acrylic.

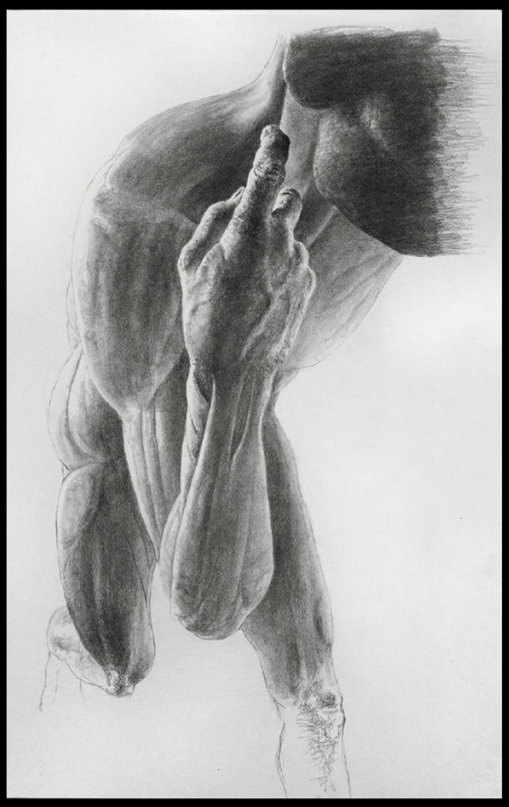




African *Homo erectus* female body blueprint. Digitally manipulated graphite drawing.

Opposite:
(South) *African Homo* erectus skull. Pen and ink on acrylic- and sand-washed board.

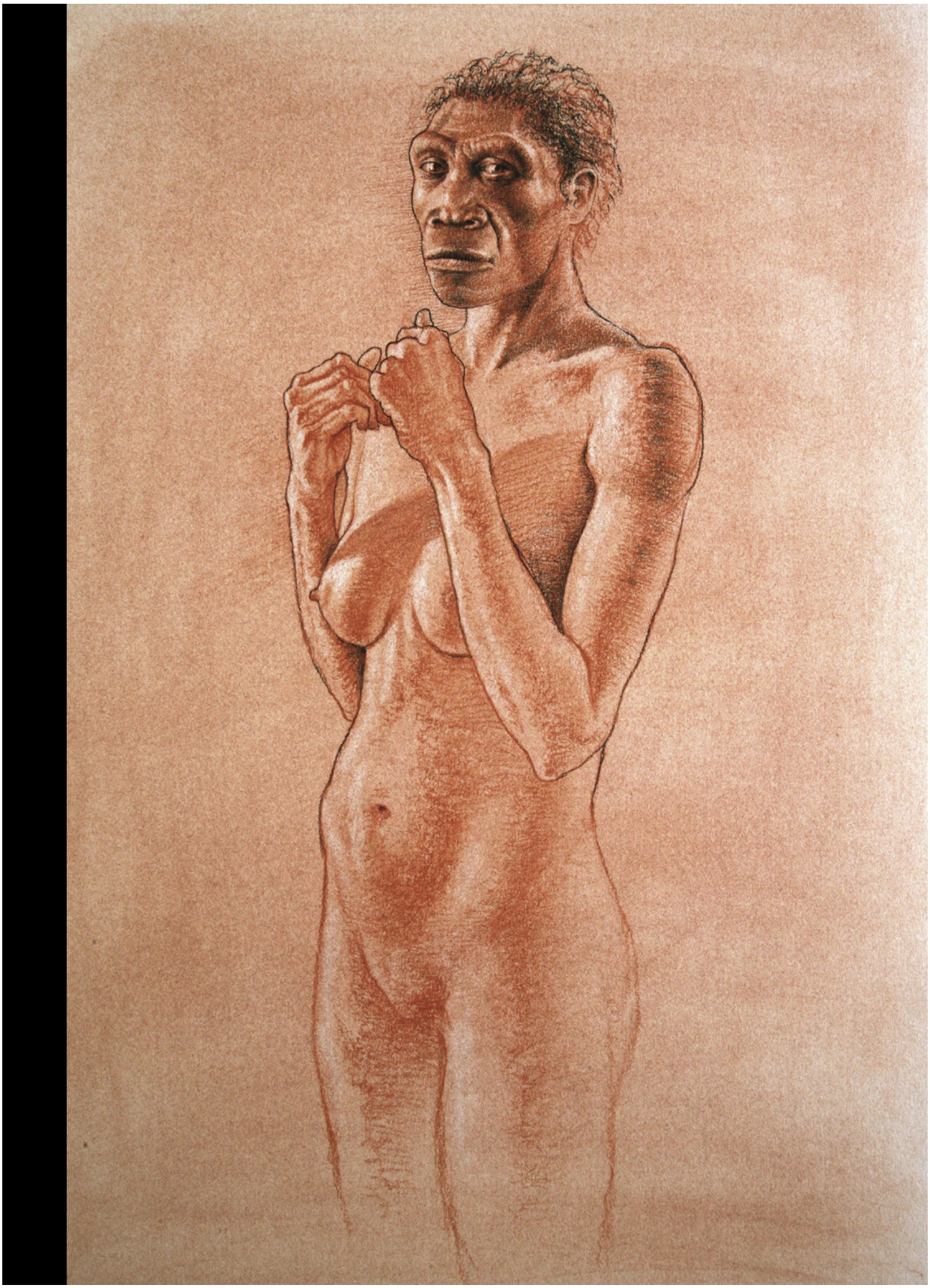


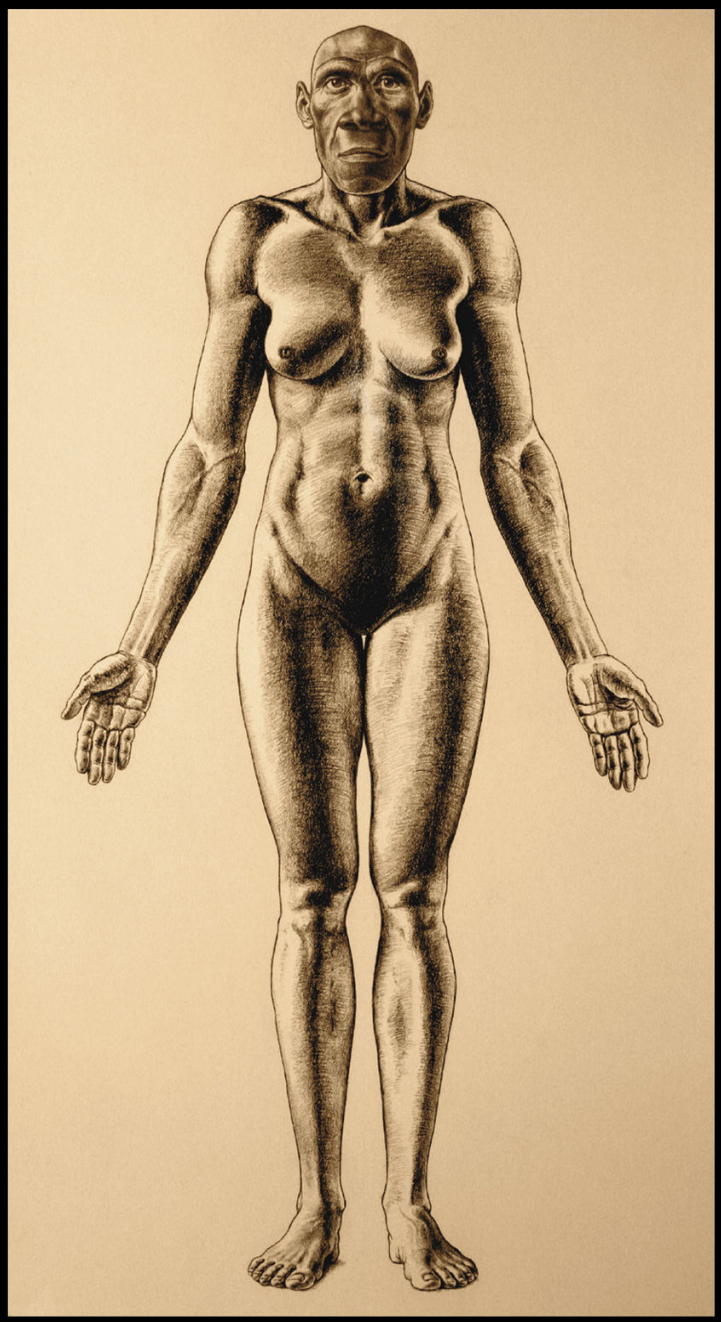


Left:
African ***Homo erectus*** female, musculature. Pen and ink with acrylic on board.

Right:
African ***Homo erectus*** female, musculature. Graphite on paper.

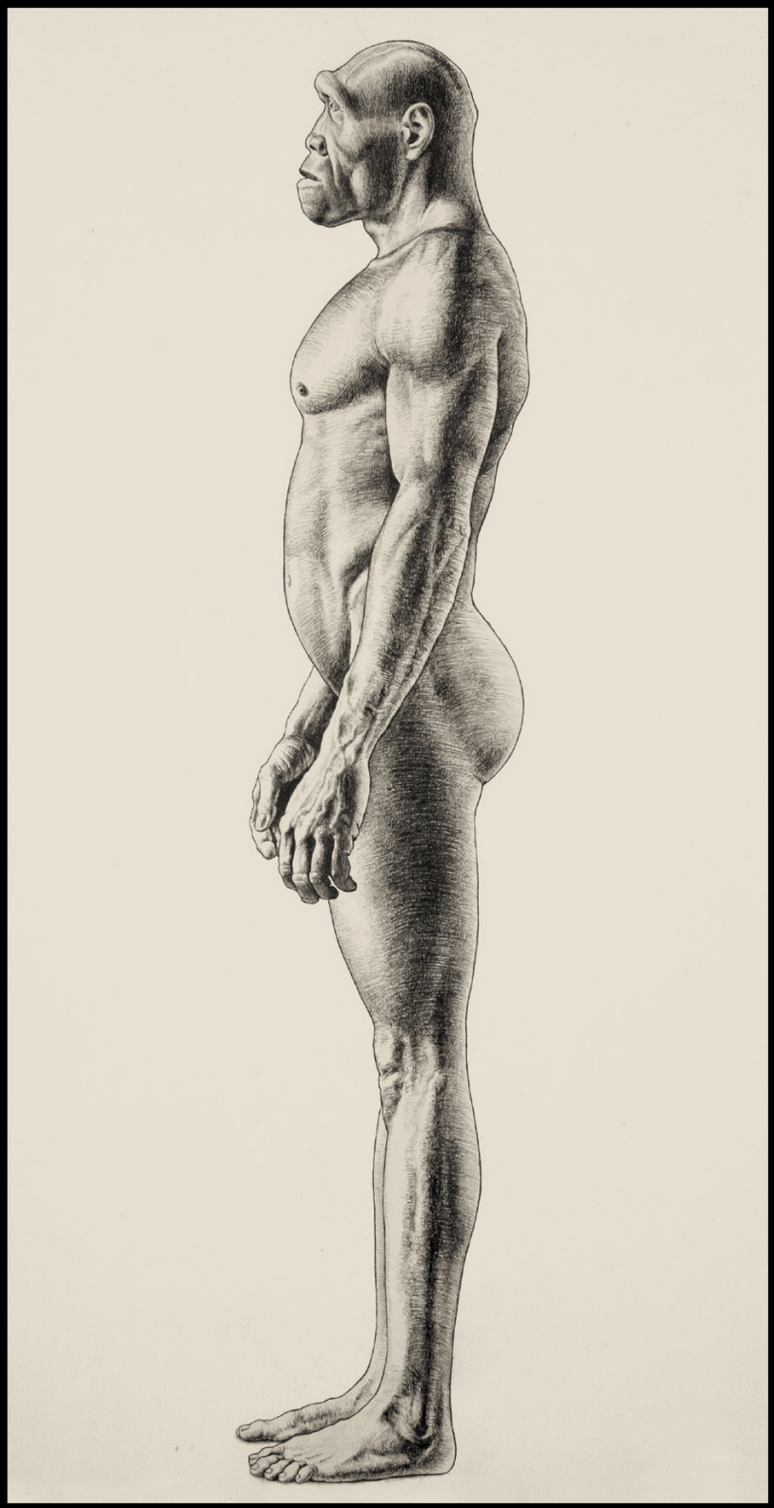
Opposite:
African ***Homo erectus*** female figure. Chalk on paper.

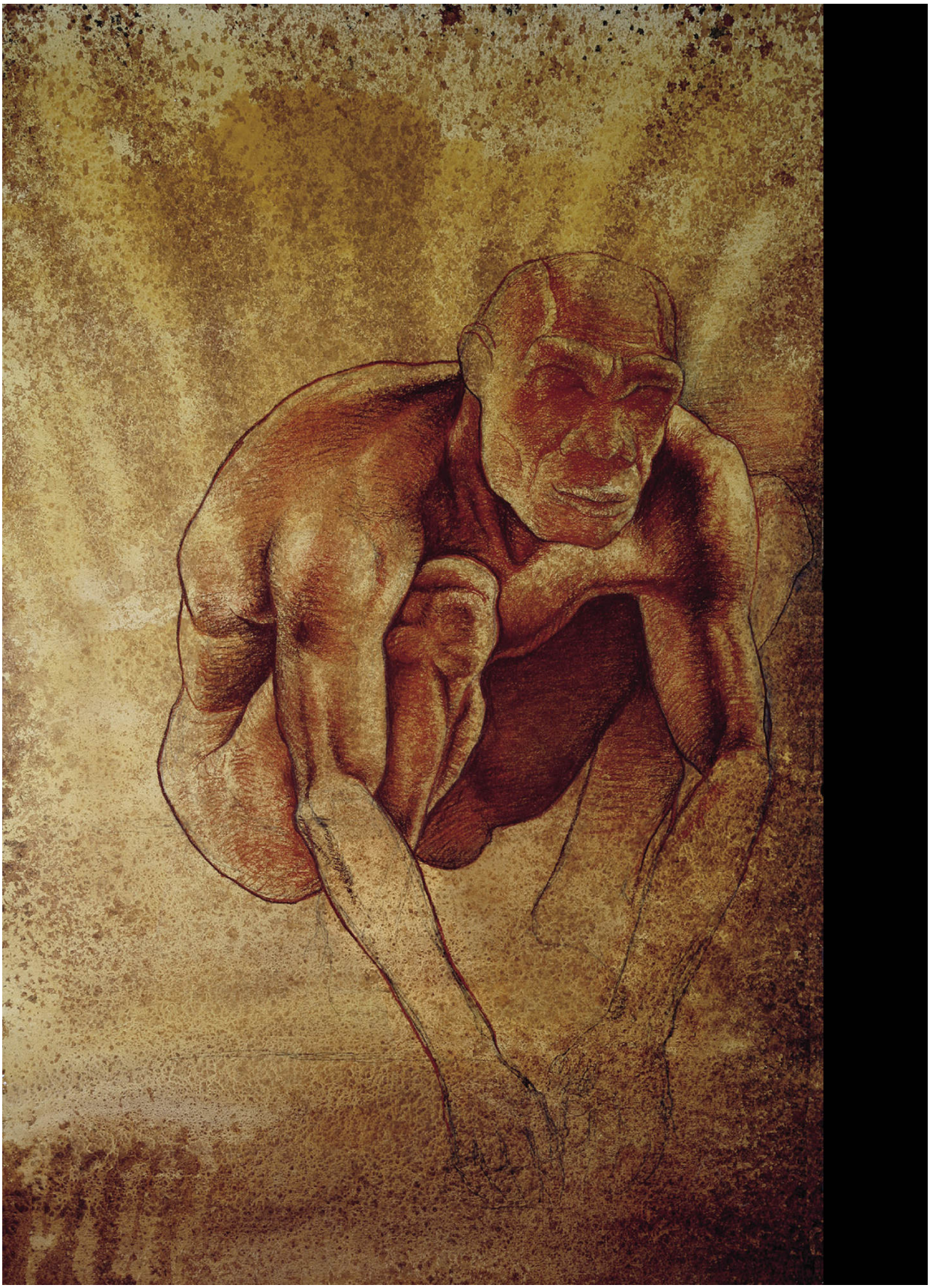


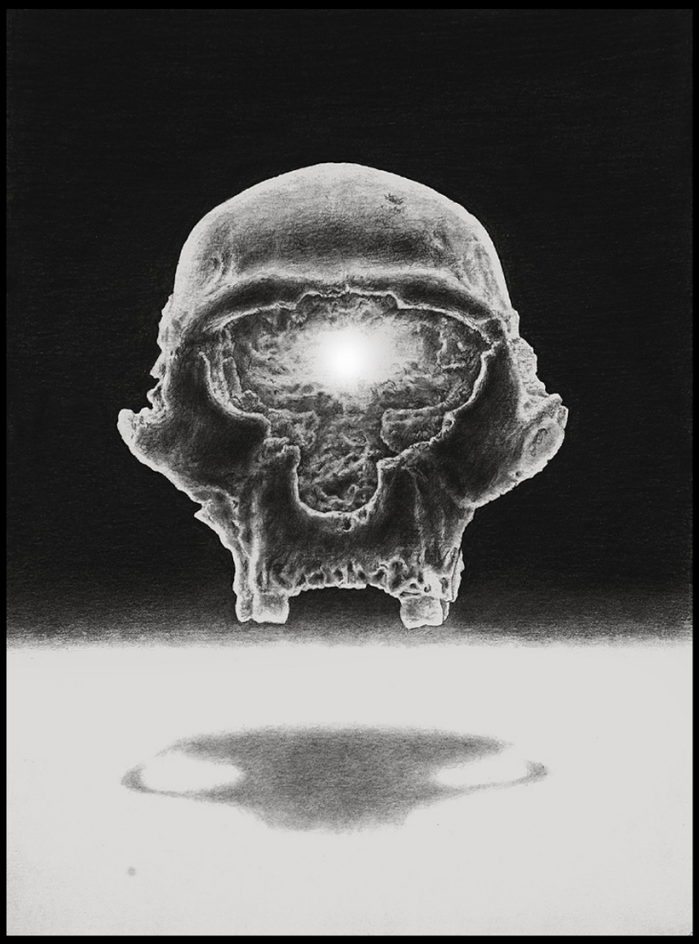


African *Homo erectus* female figure. Graphite on board, digitally colored.

Opposite:
African *Homo erectus* male figure. Graphite on board.

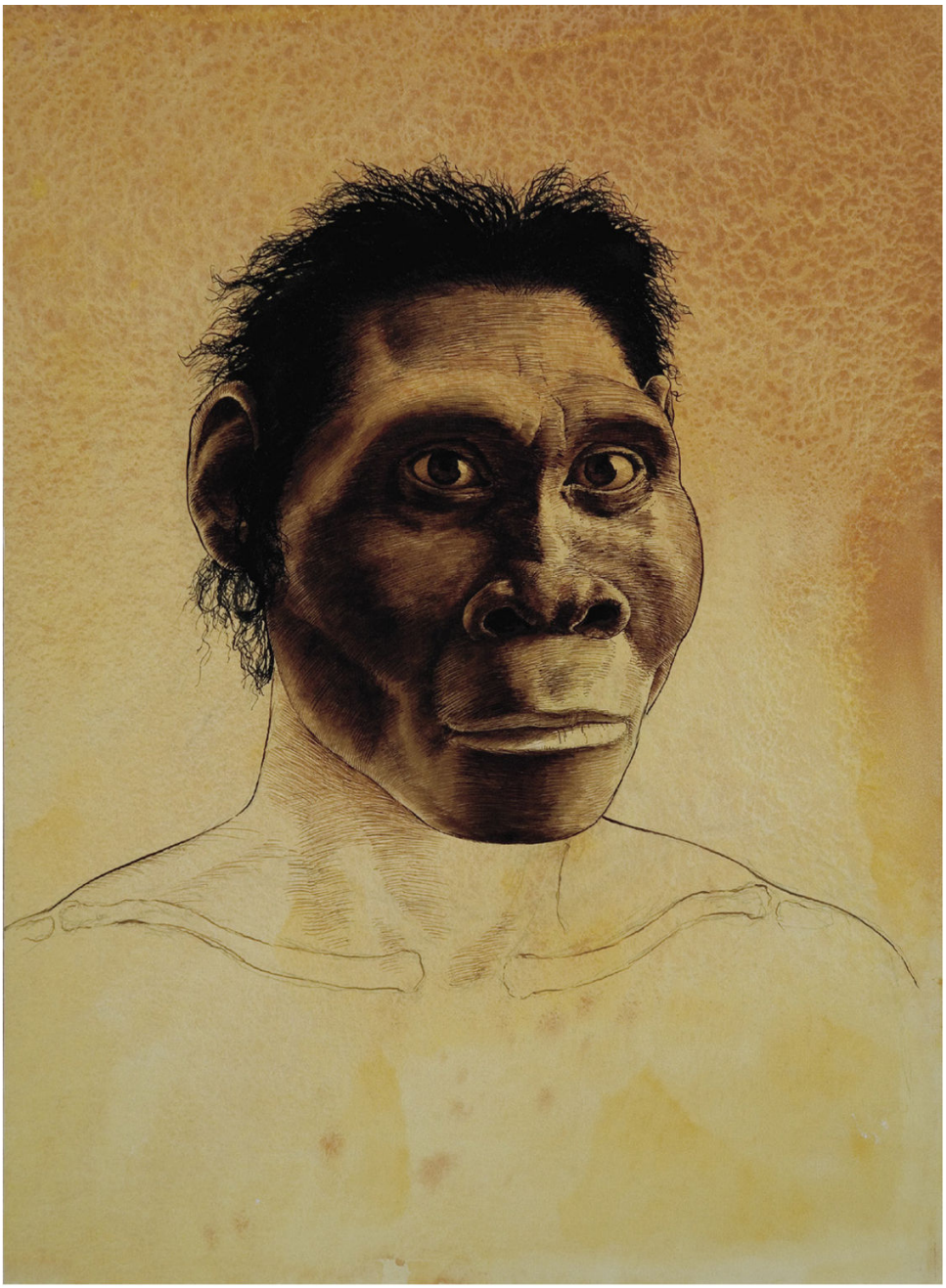






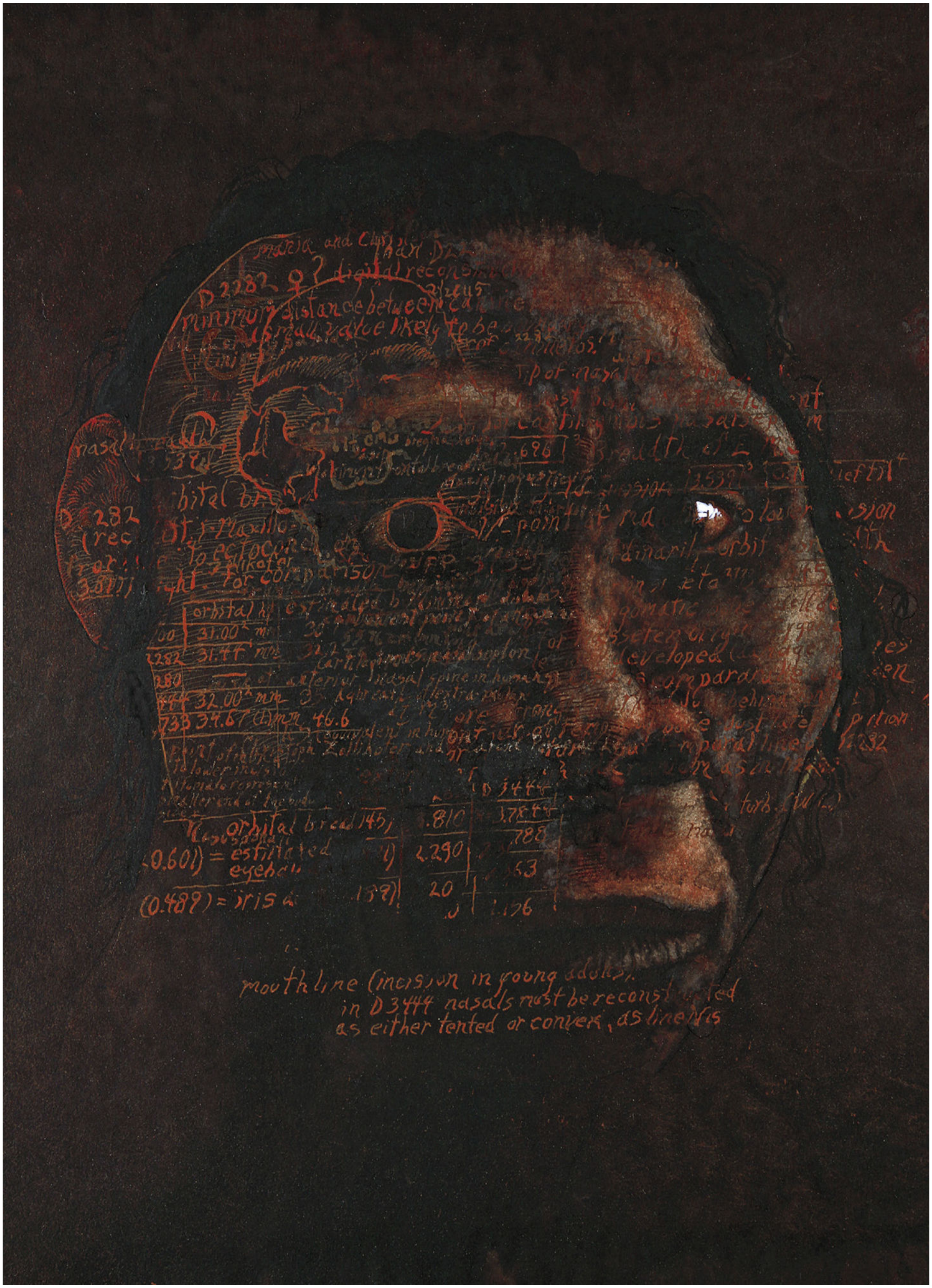
Homo erectus Skull 2 from Dmanisi, Republic of Georgia. Graphite on paper.

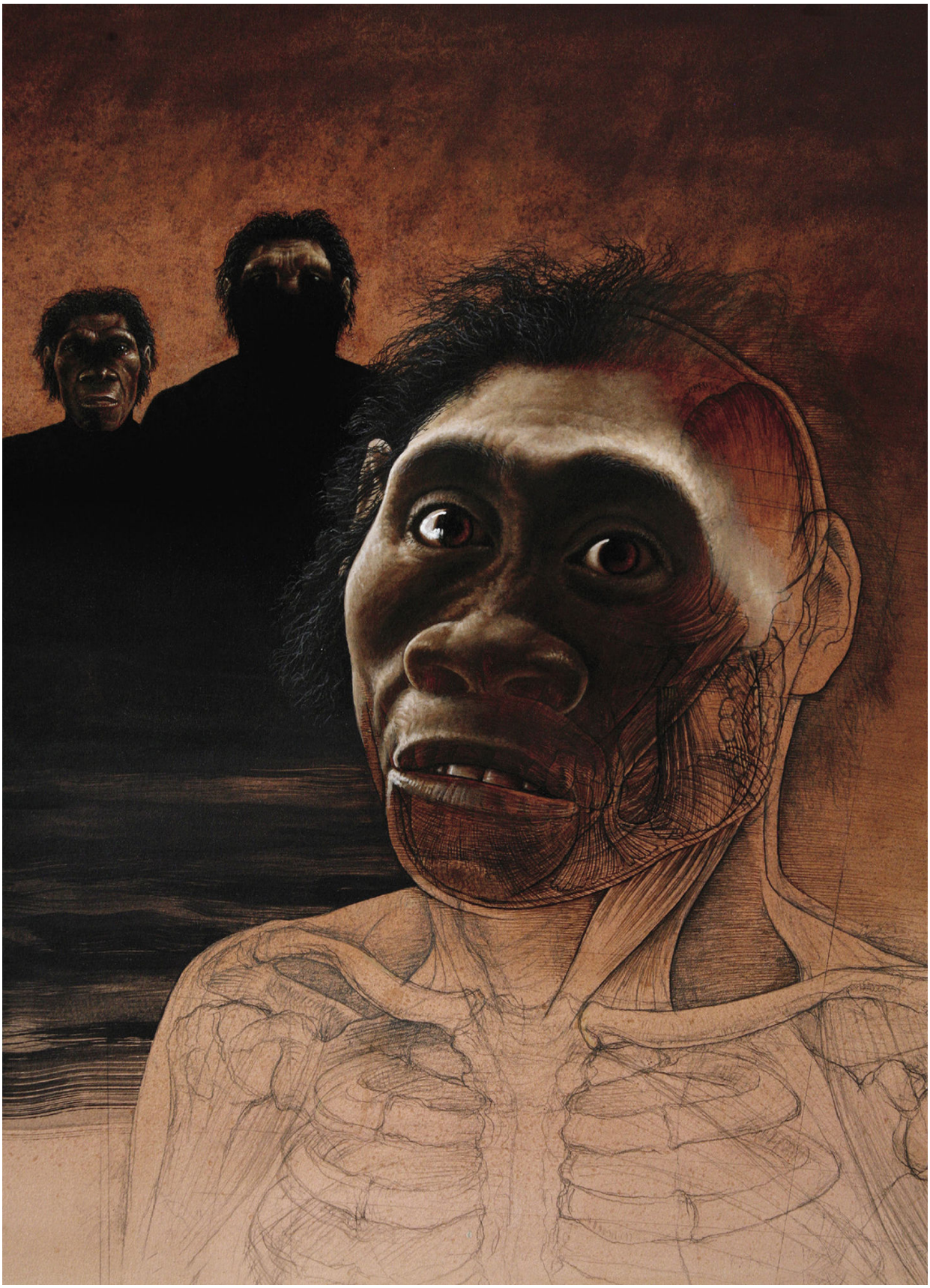
Opposite:
Homo erectus male figure. Red and black chalk on sand- and acrylic-washed board.

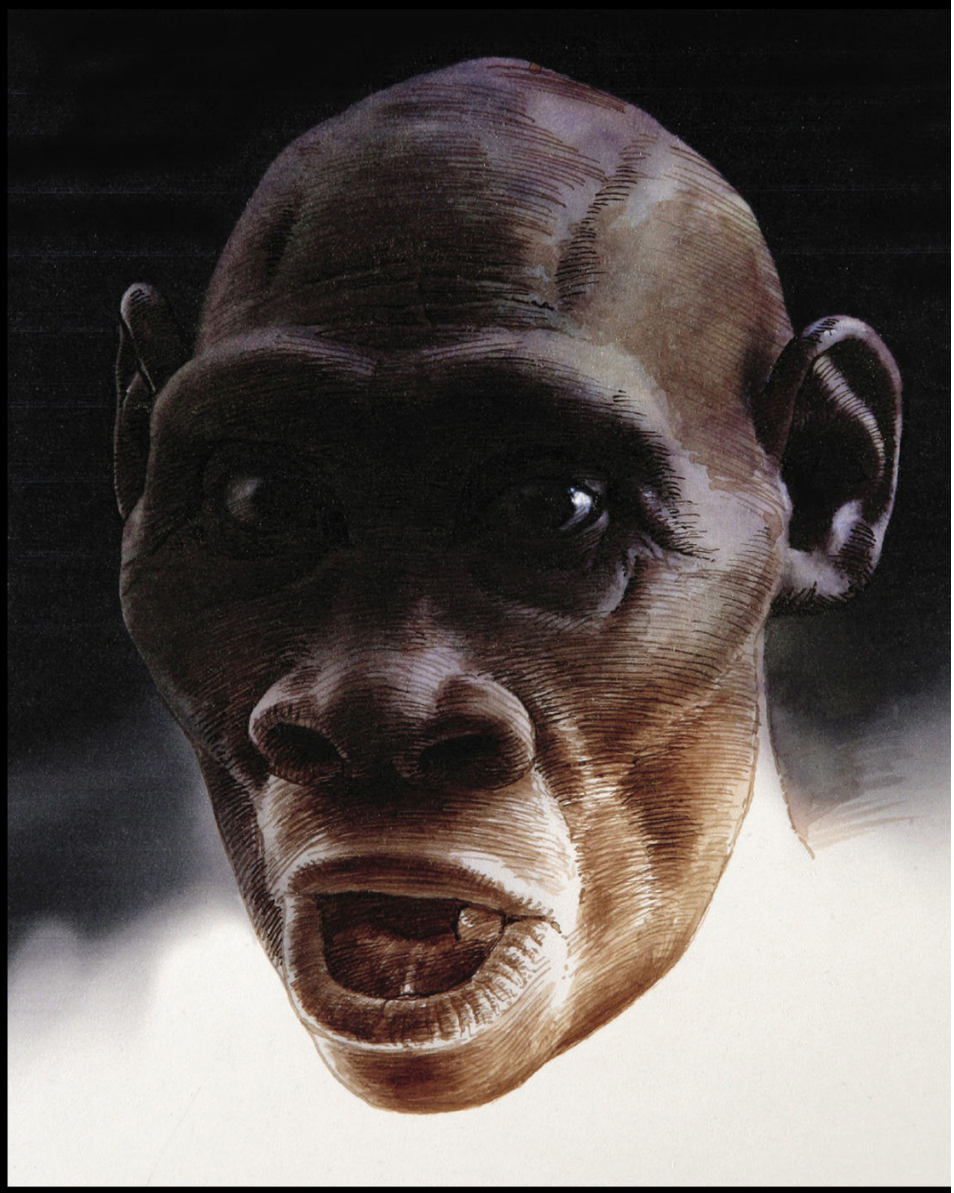


Homo erectus female, based on Skull 2 from Dmanisi. Pen and ink on sand- and acrylic-washed board.

Opposite:
Homo erectus female with anatomical notes, based on Skull 2 from Dmanisi. Ink and acrylic.

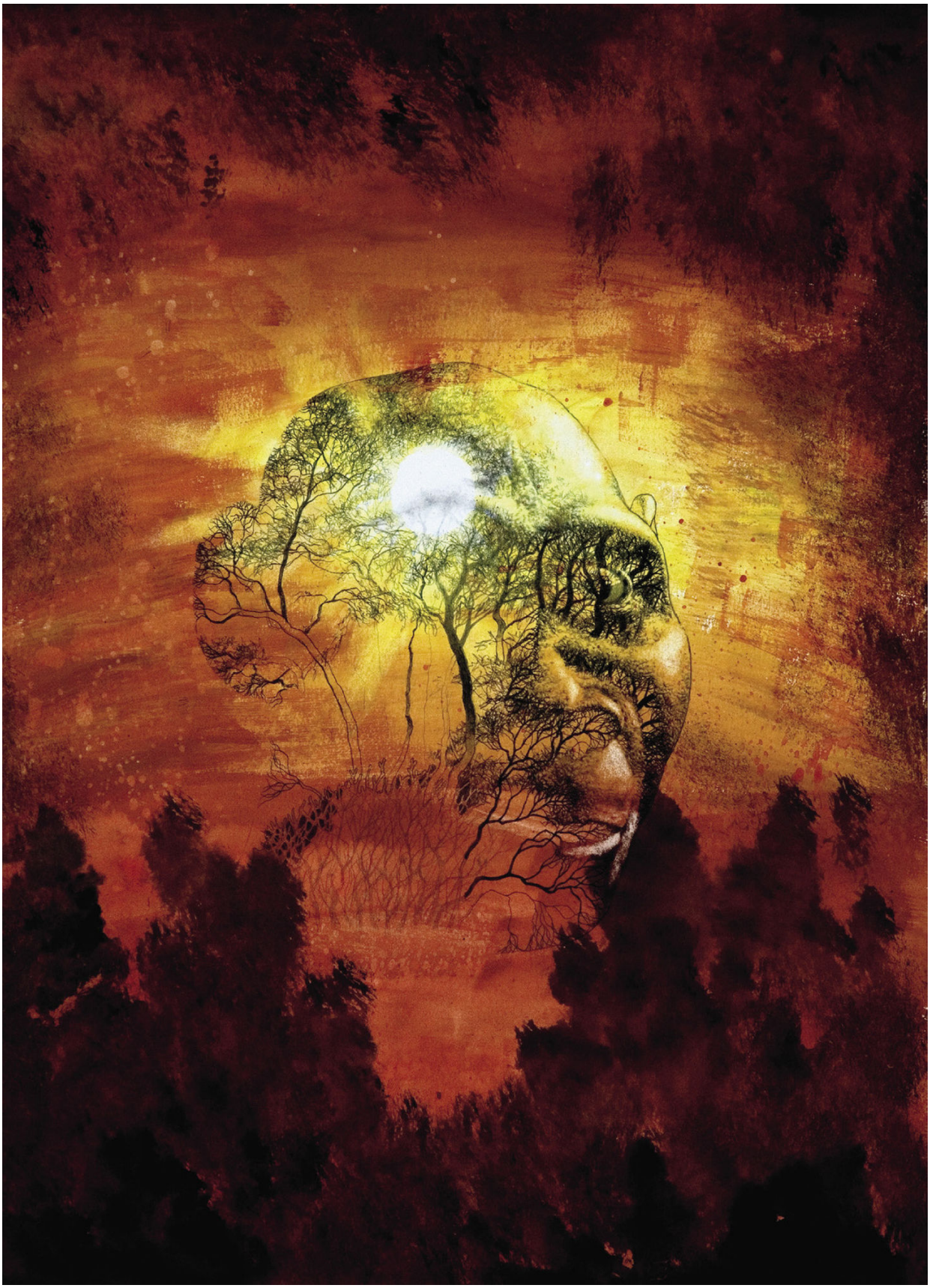

mouthline (incision in young adults,
as either tented or convex, as line is





Homo erectus male, based on Skull 4 from Dmanisi. Pen and ink with acrylic on paper.

Opposite:
Homo erectus subadult female, based on Skull 3 from Dmanisi. Pen and ink with graphite and acrylic.



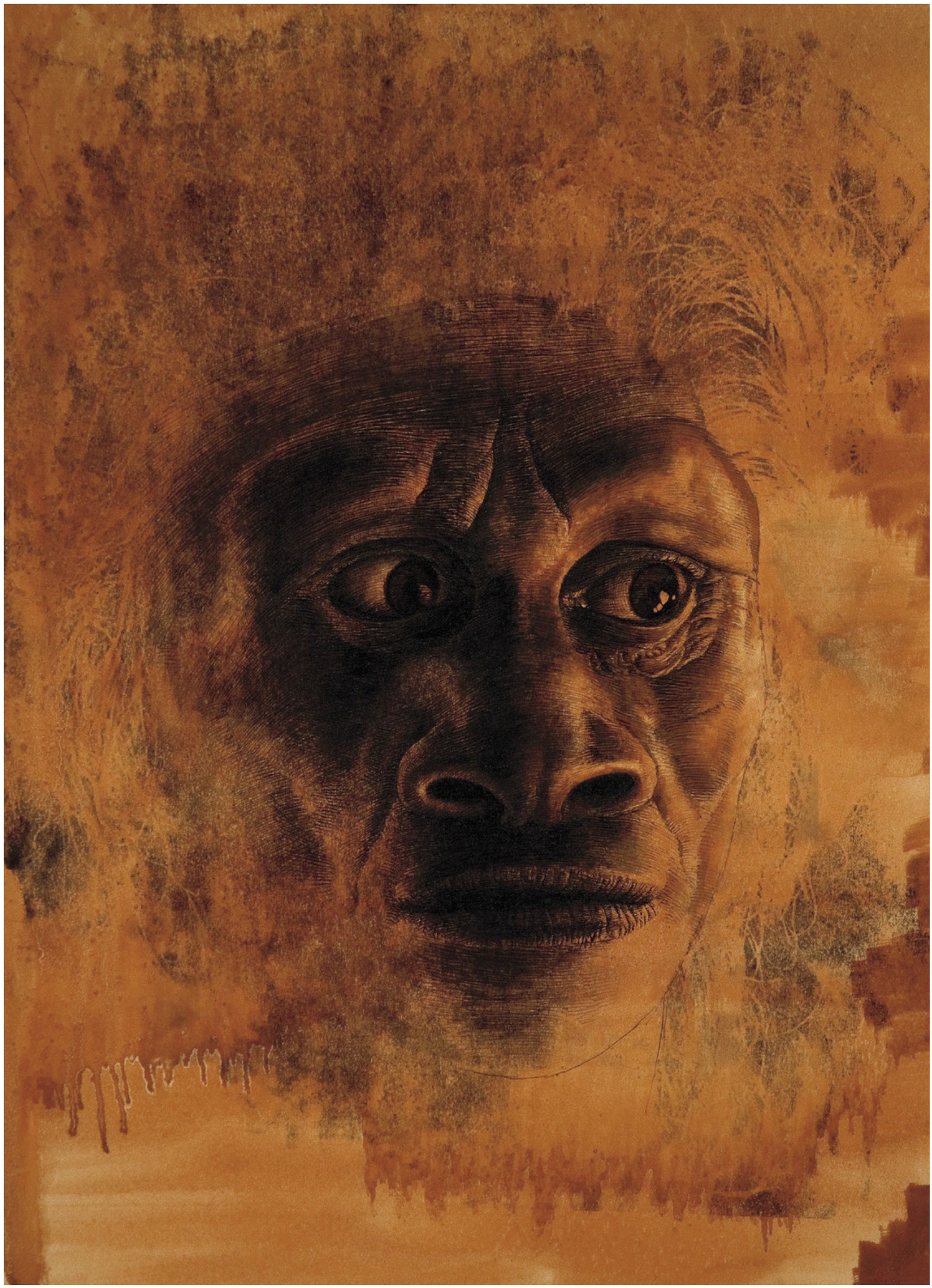
Homo erectus. Graphite on acrylic-washed board.

Opposite:
Homo erectus. Graphite and acrylic on board.

Homo naledi composite male skull. Graphite on paper.

Right:
Homo naledi foot skeleton. White chalk with red ink on black acrylic painted board.

Opposite:
Homo naledi. Watercolor with black chalk on acrylic painted board.

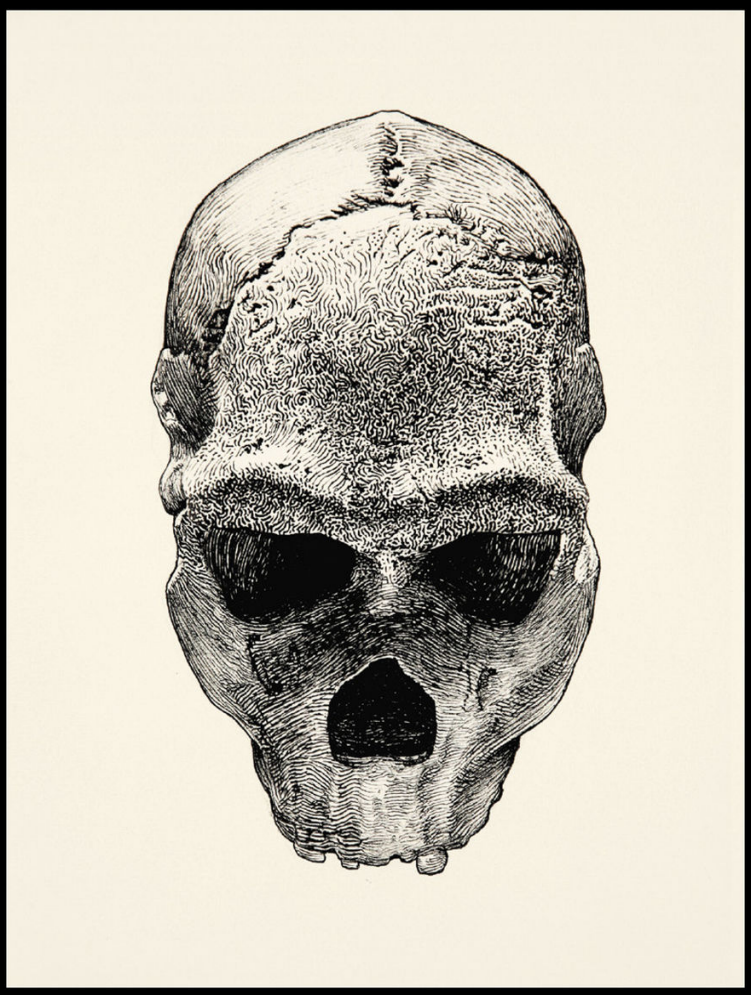


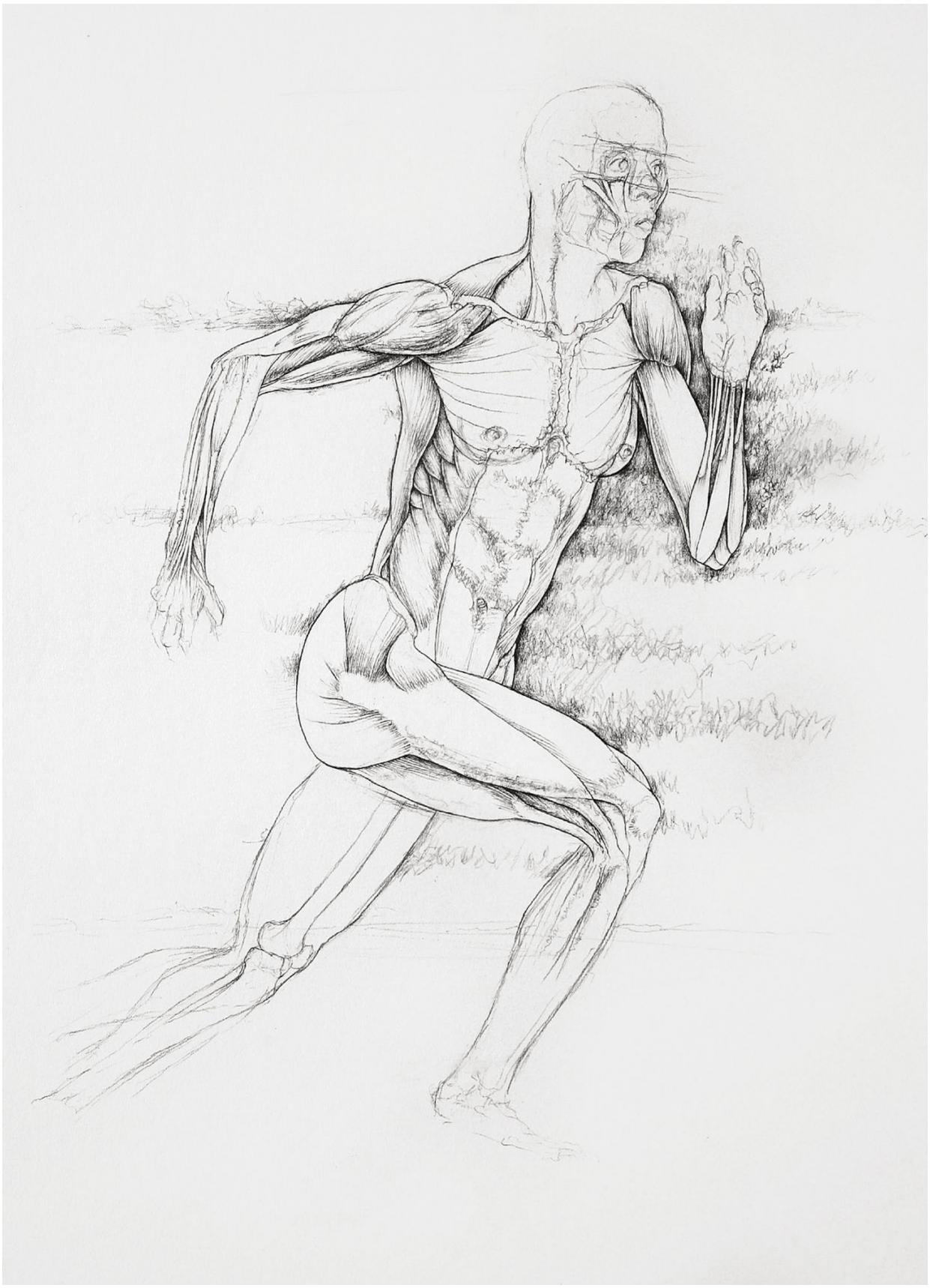
Homo floresiensis female. Graphite on paper.

Opposite:
Homo floresiensis female. Pen and ink with acrylic.

Trenton W. Holliday

4 DERIVED *HOMO*





Previous page:
Homo heidelbergensis male skull. Pen and ink on paper.

Opposite:
Homo sapiens female at a fast clip, with musculature visible. Graphite on paper.

There is no respite from the relentless summer sun in this three-thousand-square-foot, thirty-foot-deep hole. This open pit used to be a sheltering cave with a nearly constant air temperature, but its collapsed roof was removed decades ago, and now there is no shade to be found anywhere. Unfortunately for us, it's a scorcher, too, at 38°C. I do the math in my head: That's 100°F. So much for leaving the heat of my Louisiana home behind to enjoy the milder climes of France. But this is no time for complaining; there is work to be done!

The site we are excavating is Regourdou, in southwestern France, in the Périgord region near the town of Montignac. I was invited here by my old friend Dr. Bruno Maureille, who wants to reopen it. Here, in 1954, a farmer, the late Roger Constant, began excavating a cave on his property, and in 1957 a fairly complete Neanderthal (*Homo neanderthalensis*) skeleton known as Regourdou 1 was found. Most of the skeleton was removed during a salvage operation that same year, but subsequent fieldwork in the 1960s recovered more of his remains, as well as at least one bone of a second presumed Neanderthal individual (Regourdou 2).

Today, Constant's niece Michèle runs Regourdou as a tourist attraction, complete with live bears. As I work, in addition to the bears' occasional growls, I overhear the tour guides above explaining to visitors what my colleagues and I are doing. They are making it sound much more glamorous than it really is. What we are actually doing is removing tons of sterile debris (the overburden, as archaeologists call it), in the hope that we can then get to the real work of carefully excavating artifact- and bone-laden layers below it. I am indeed using a pickax to break up limestone blocks, which will later be dumped onto another section of the Constant property. As sweat stings my eyes and pours down my back, I cannot help thinking that all

I need to complete my ensemble would be a black-and-white-striped jumpsuit, a pillbox hat, and a ball and chain attached to my ankle. I went through all the trouble of getting a PhD just so I could break up rocks in the hot summer sun? I *must* be one smart cookie.

That being said, I'm hopeful all the backbreaking work is worth it, because the site of Regourdou holds great promise. Our team's preliminary radiometric dates suggest that the Regourdou 1 Neanderthal was buried (intentionally or not) around 100,000 years ago, which would make it one of the oldest associated Neanderthal skeletons. Even more exciting is that the Regourdou 1 cranium, which was never found, may still lie somewhere in the ancient sediments of the site—sediments we soon hope to be sifting through.

In my mind's eye, I try to picture this hot, sunny place as a cool, dark cave, high up on a cold, windy, and mostly treeless ridge some 100,000 years ago. I imagine a band of Neanderthals coming here seeking shelter from the Ice Age cold. There were almost certainly many times, however, when they could not remain in the cave, for it held other denizens. In particular, Regourdou has yielded the remains of dozens of brown bears, which is one of the reasons Roger Constant acquired live bears to attract visitors to the site.

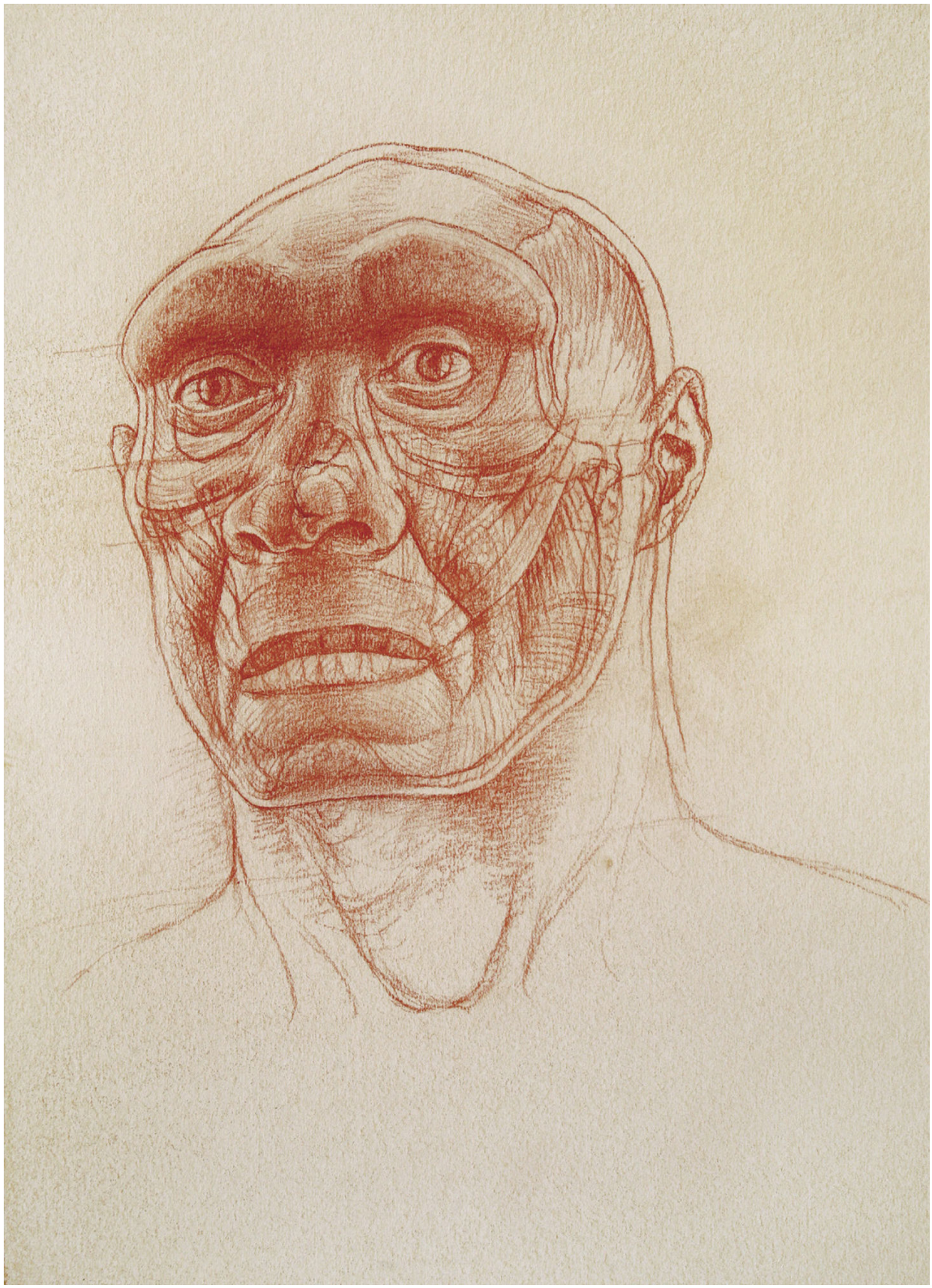
In 2016, I myself found a fragment of the Regourdou 1 skeleton in a box labeled, in French, "*Ours*" (Bear). It is a major portion of the left os coxae, or hip bone. The fact that this bone was mistaken for the pelvis of a bear points to an aspect of the anatomy of prehistoric *Homo* that John Gurche captures so well in his art. These hominins were robustly built, muscular people. Take a look at John's beautiful rendering of the well-muscled back of the La Ferrassie 1 Neanderthal, for example (page 185). Perhaps an even more striking example is his study of the anatomically modern (c. 26,000-year-old) female from the Czech site of Předmostí. Gazing at her muscled form, one almost has to remind oneself that this is a woman (page 188).

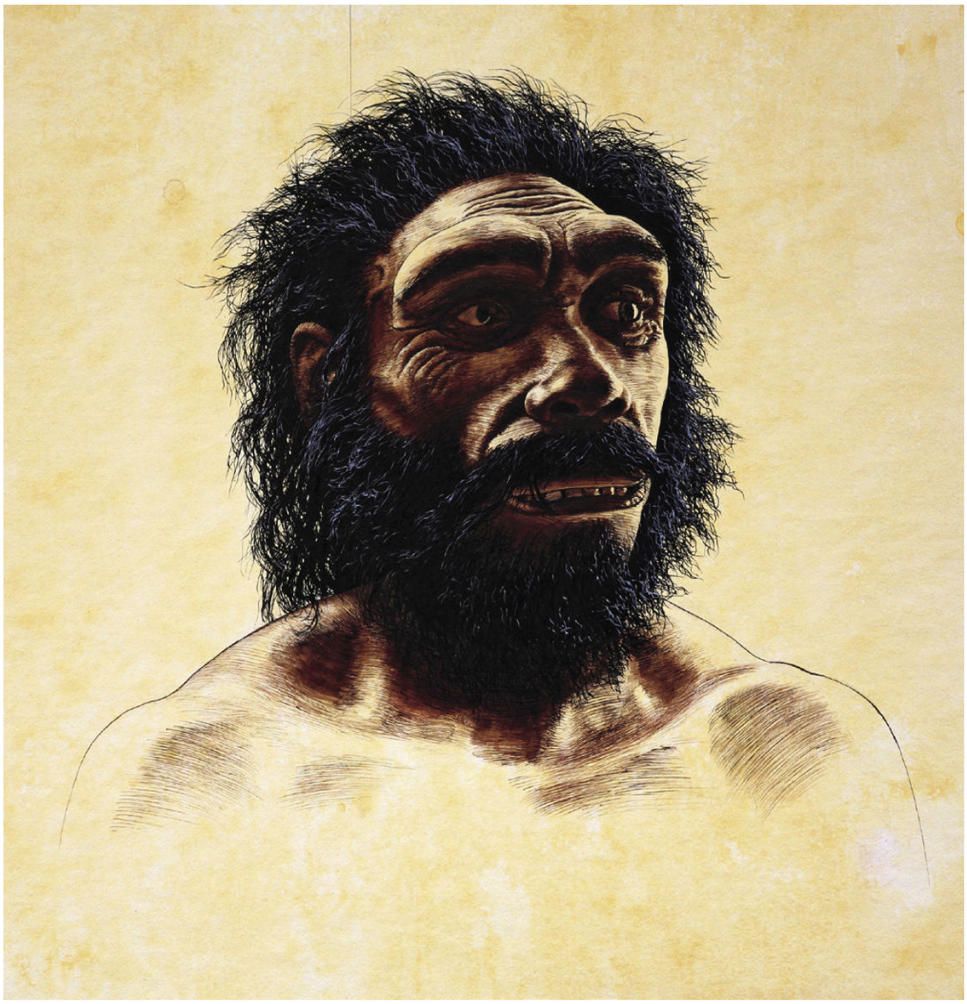
Homo neanderthalensis, like Regourdou 1 and La Ferrassie 1, is humanity's closest fossil relative, having diverged from our own species, *Homo sapiens*, perhaps as recently as 400,000 years ago. These stocky, muscular humans with big faces, teeth, and brow ridges (smaller than those of their presumed ancestors, *Homo heidelbergensis*) ranged across Europe and into Asia as far east as southern Siberia. Most lived in cold climes, a fact to which their broad bodies and short limb bones (not unlike those of modern-day Inuit or Sami) attest. Look, for example, at John's drawings of the La Ferrassie 1 Neanderthal. Because they frequently buried their dead (see John's rendering of the Kebara 2 burial, page 12, for a prime example), they are the best-represented fossil hominin taxon (aside from *Homo sapiens*) in terms of sheer number of specimens. Neanderthals are thought to have had rituals (Regourdou was argued to have been one such ritual site), and they are known to have created art. In addition, their evolutionary fate and the questions surrounding how and where our own species first evolved have been intimately tied together since the first Neanderthal specimen was first recognized as a non-modern form of *Homo* in 1856. We now know from genetic studies that Neanderthals and modern humans were able

to successfully interbreed, and that many, if not most, of you reading this paragraph can count a Neanderthal among your ancestors.

We call *Homo neanderthalensis* a derived member of the genus *Homo,* which simply means that it was marked by evolutionary novelty. Others portrayed in this chapter include *Homo heidelbergensis* and (of course) *Homo sapiens*. *Homo heidelbergensis* is the earliest (and most primitive) taxon. First appearing in the Middle Pleistocene, which began about 780,000 years ago, they anatomically resemble heavier, more robust, and bigger-brained versions of their predecessors, *Homo erectus,* in many ways. What I find most intriguing about *Homo heidelbergensis* is the presence of modern brain sizes in the context of huge cranial superstructures such as brow ridges, whose evolutionary purpose is an area of unresolved debate. This otherworldly anatomical mix is especially apparent in John's beautifully detailed study of the Petralona specimen from Greece (page 169).

Finally, *Homo sapiens* is the cosmopolitan species to which every living human belongs, but, as John's art so elegantly shows, early members of our own species evince significant anatomical differences from people today (such as thicker, stronger limb bones and longer and lower cranial vaults), and we know from mathematical clustering of morphological data that many of these early *Homo sapiens* fall completely outside the range of variation of living humans. It is perhaps hubris to think that once our own species had emerged, it ceased to evolve; that is, we had *arrived*. From a practical standpoint, there is no reason to suspect that a *Homo sapiens* individual from 200,000 years ago should fall within that narrow range of morphological variation seen among living people today. It is this observation that perhaps best encapsulates why these derived species of *Homo* have always fascinated paleoanthropologists. Put simply, they are so very much like us and yet so very different from us at the same time—and it is this tension between the ancient (or primitive) and the modern (or evolved) qualities of these hominins that makes them such interesting objects of study for John or me. Ultimately, that's what keeps us coming back to places like Regourdou.



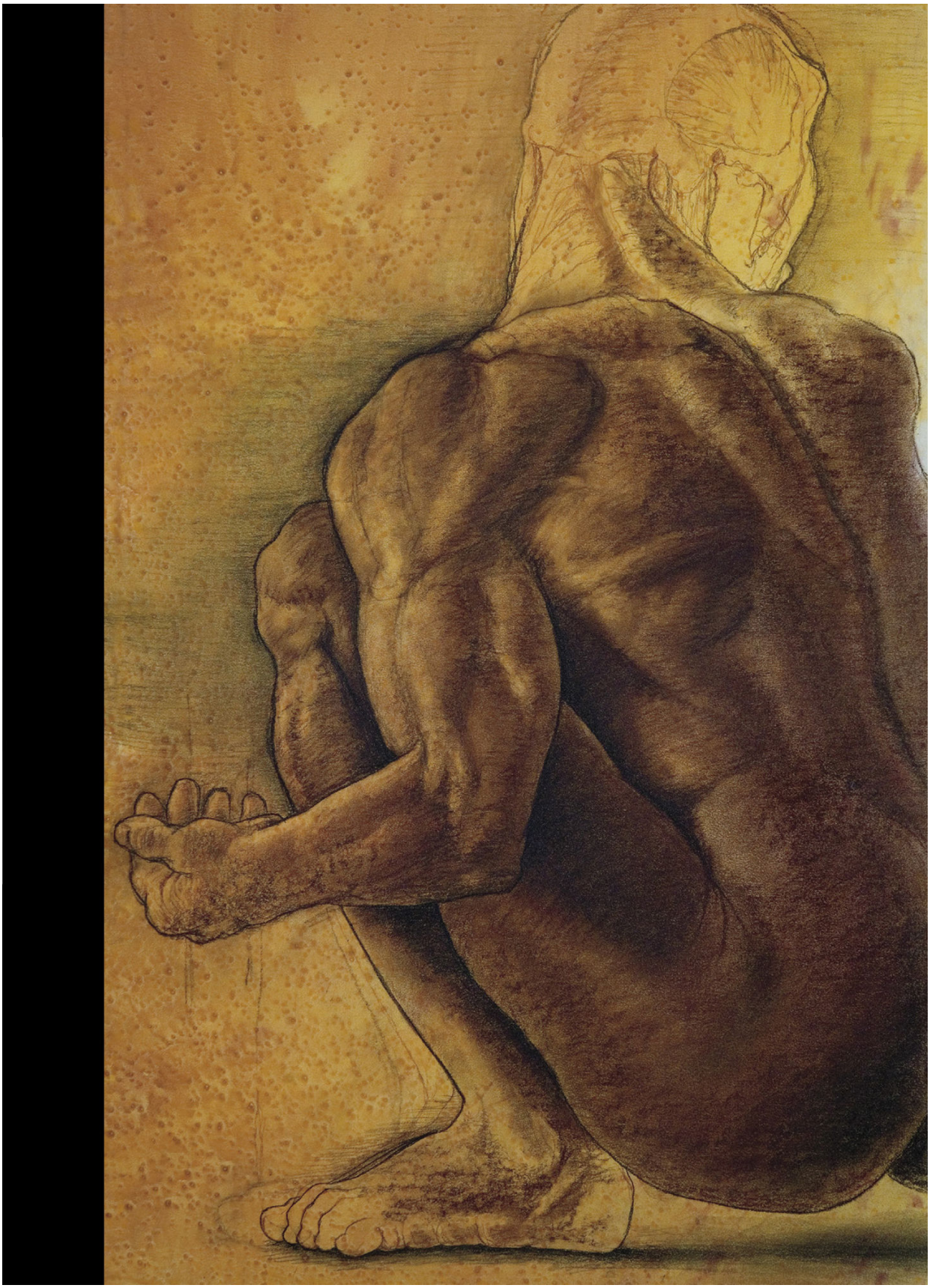


Homo heidelbergensis male. Pen and ink on acrylic-washed board.

Opposite:
Homo heidelbergensis male with reconstructed muscles of facial expression. Red chalk on colored paper.

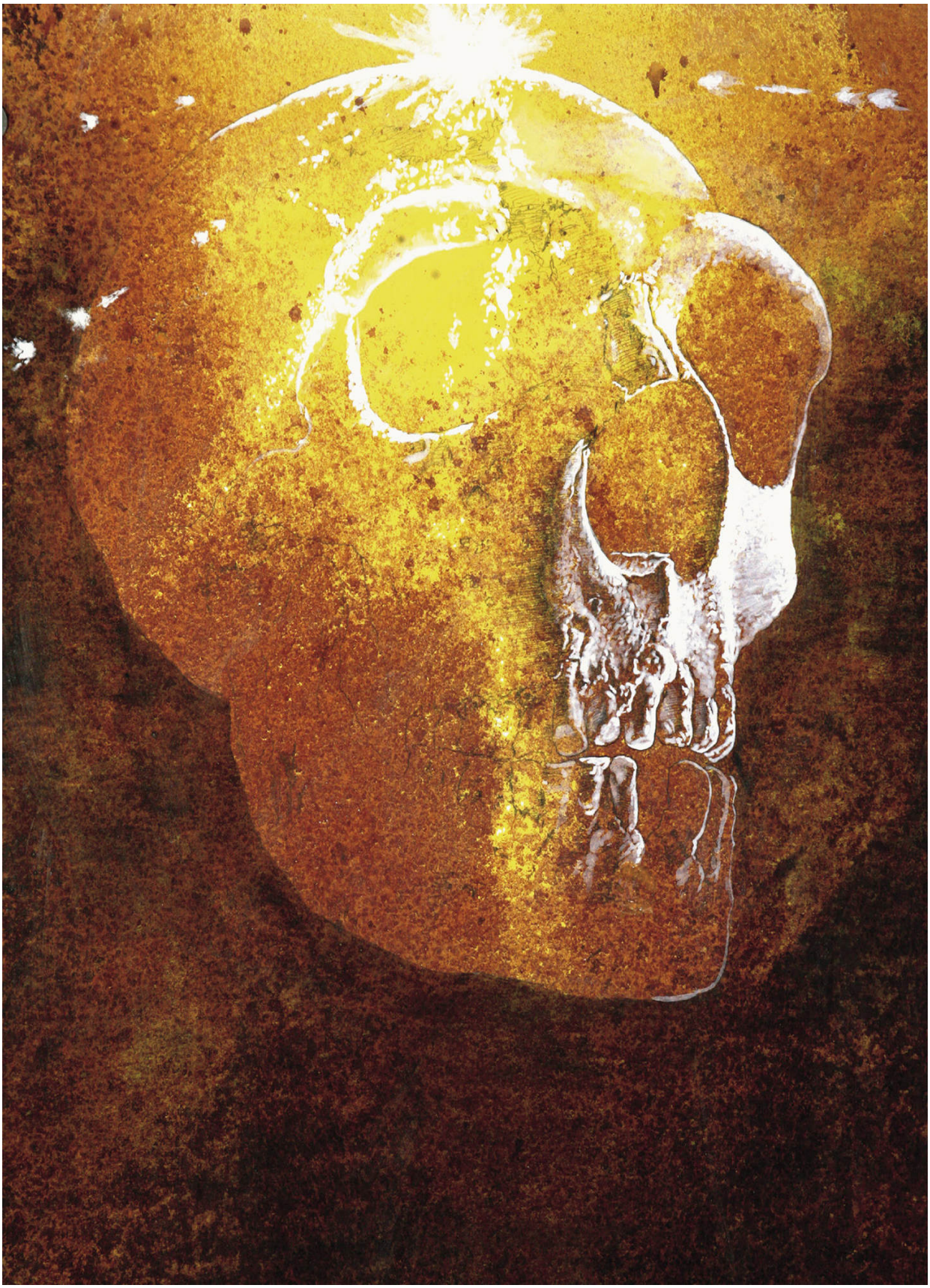
Homo heidelbergensis male figure. Red chalk on board.

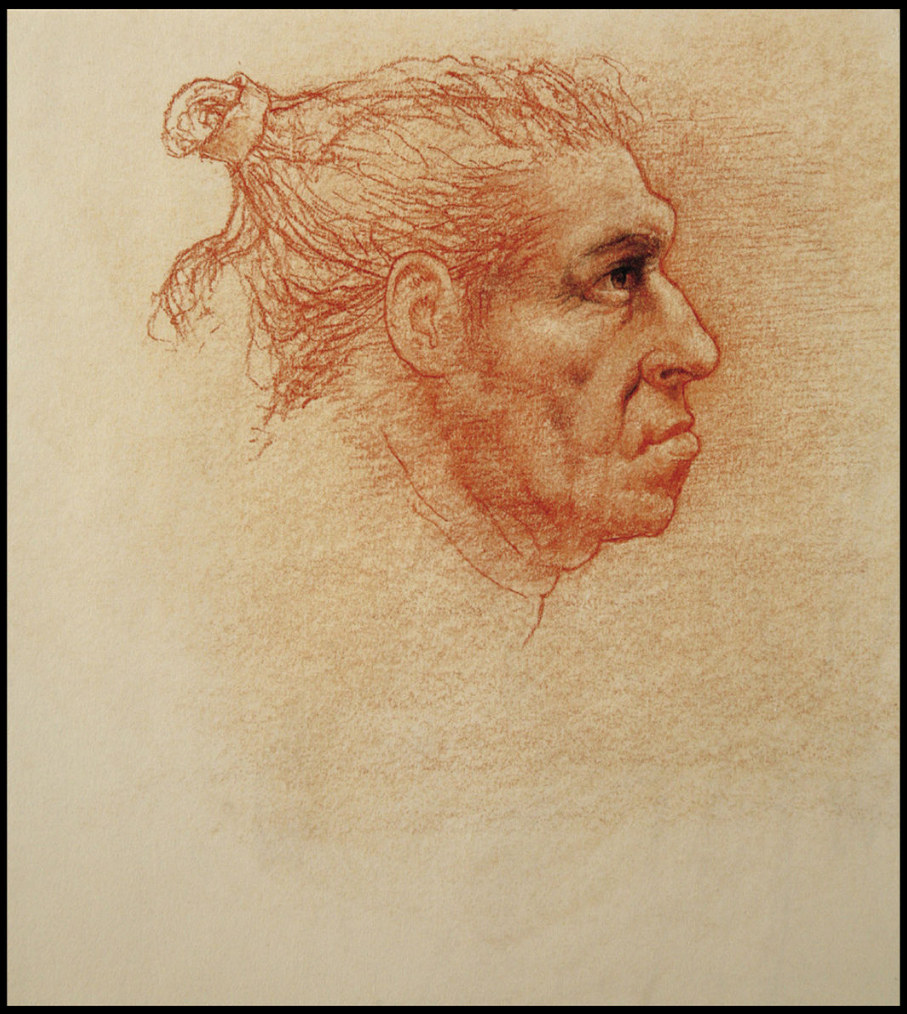
Opposite:
Homo heidelbergensis male figure. Brown and black chalk on sand- and acrylic-washed board.



Homo neanderthalensis male skull (from the site of La Ferrassie in France) and face. Graphite drawing, Xerox-transferred onto sand- and acrylic-washed board, with black ink added.

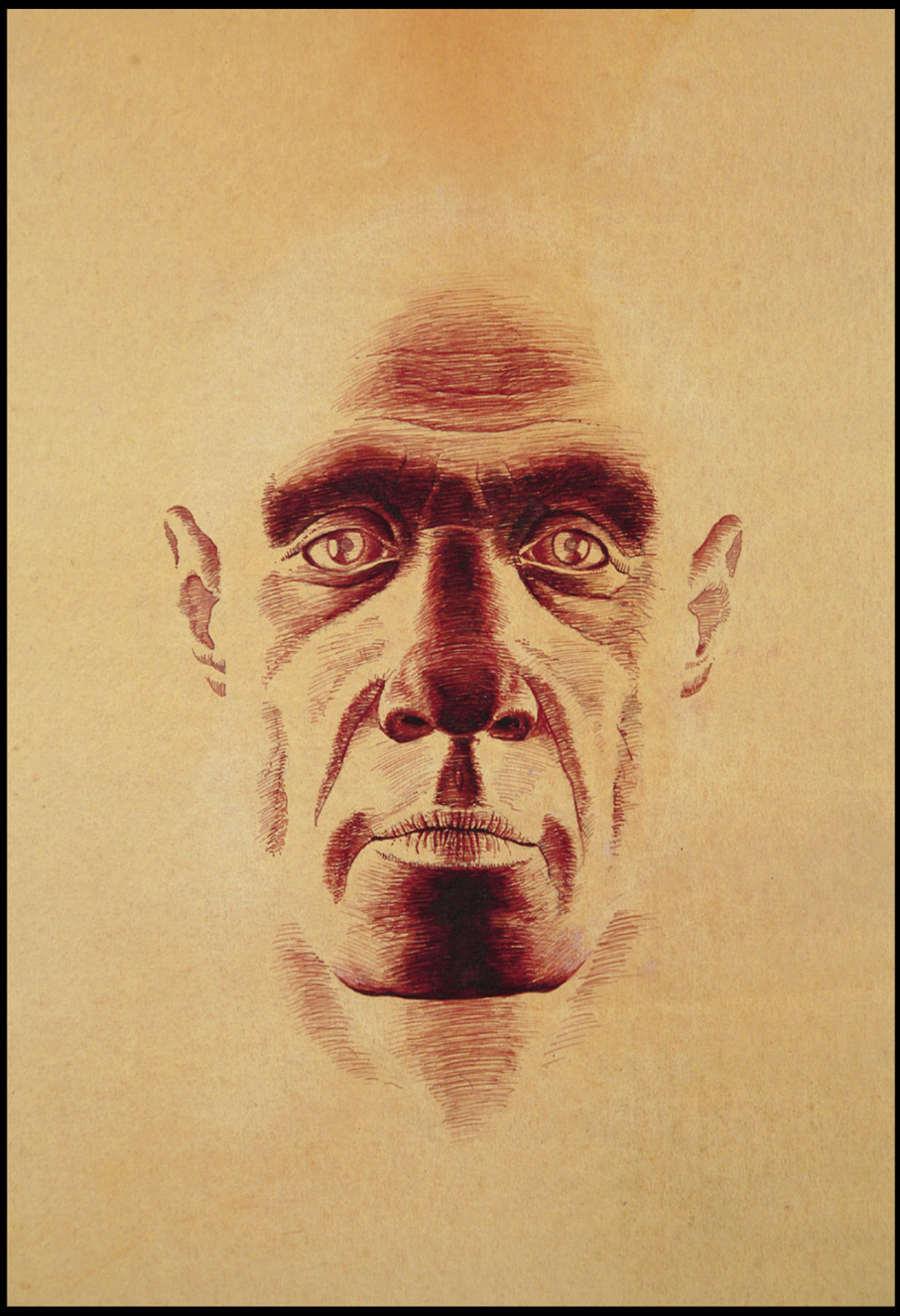
Opposite:
Homo neanderthalensis male skull (from the site of Shanidar in Iraq). Acrylic and graphite.

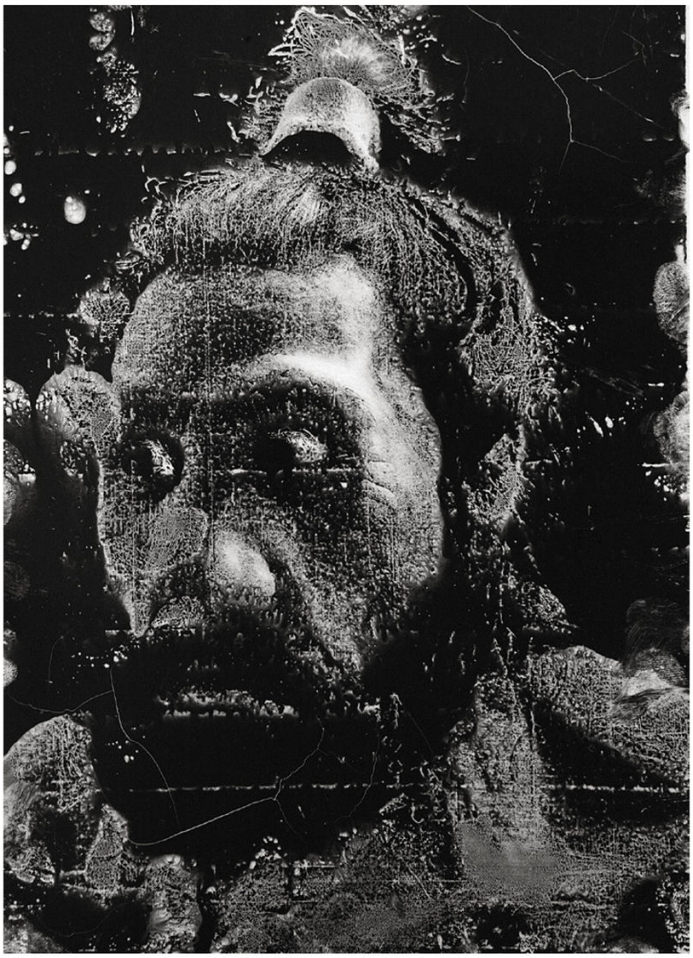




Homo neanderthalensis male, based on a skull from the site of Shanidar in Iraq. Red chalk on paper.

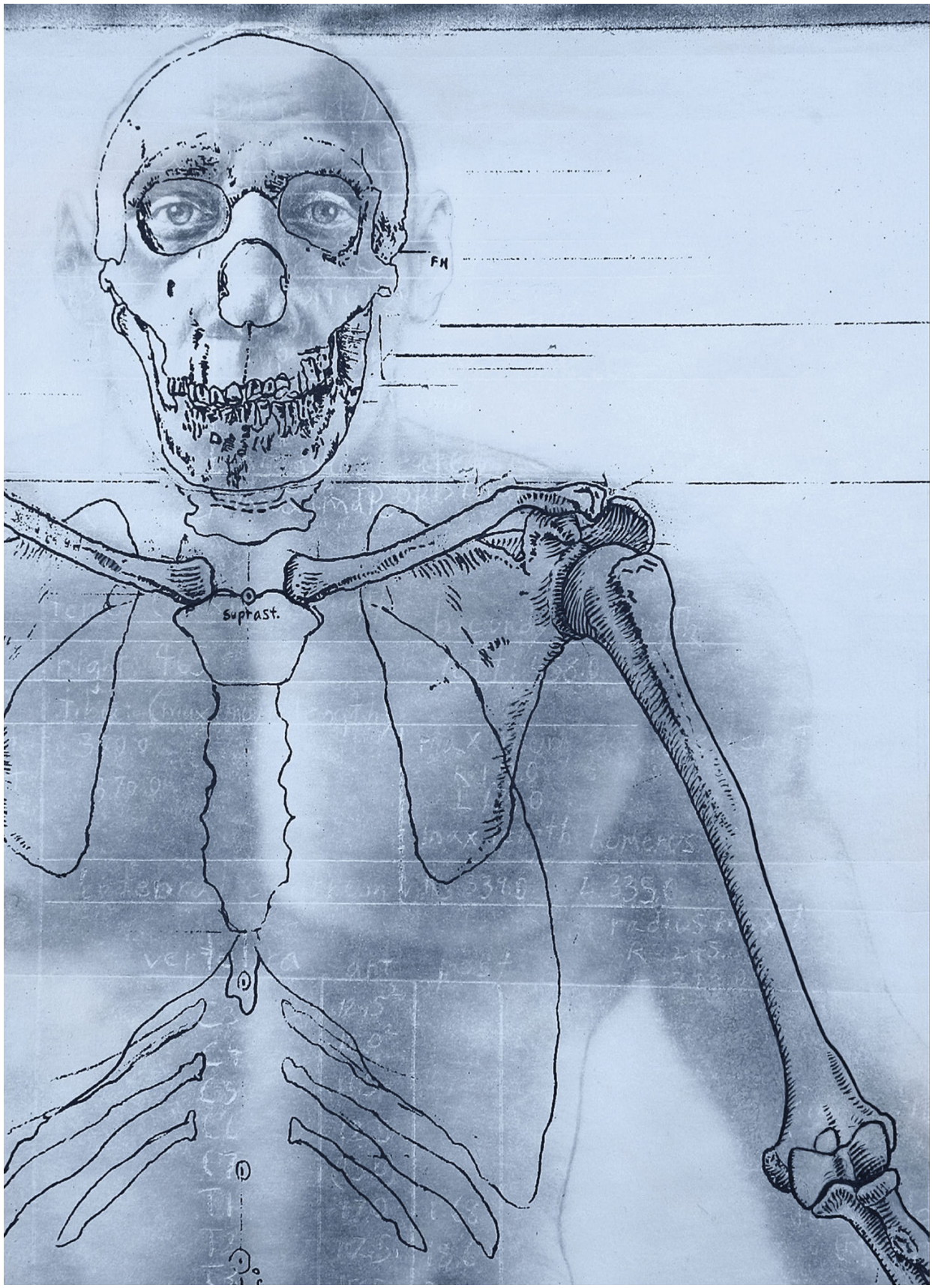
Opposite:
Homo neanderthalensis female facial reconstruction in progress, based on a skull from the Spanish site of Gibraltar. Graphite and pen and ink on board.





Homo neanderthalensis male, based on a skull from the site of Shanidar in Iraq. Sculpted 3-D reconstruction photographed, Xeroxed, liquefied, and manipulated.

Opposite:
Homo neanderthalensis male, based on a skull from the site of Shanidar in Iraq. Pen and ink on acrylic-washed board.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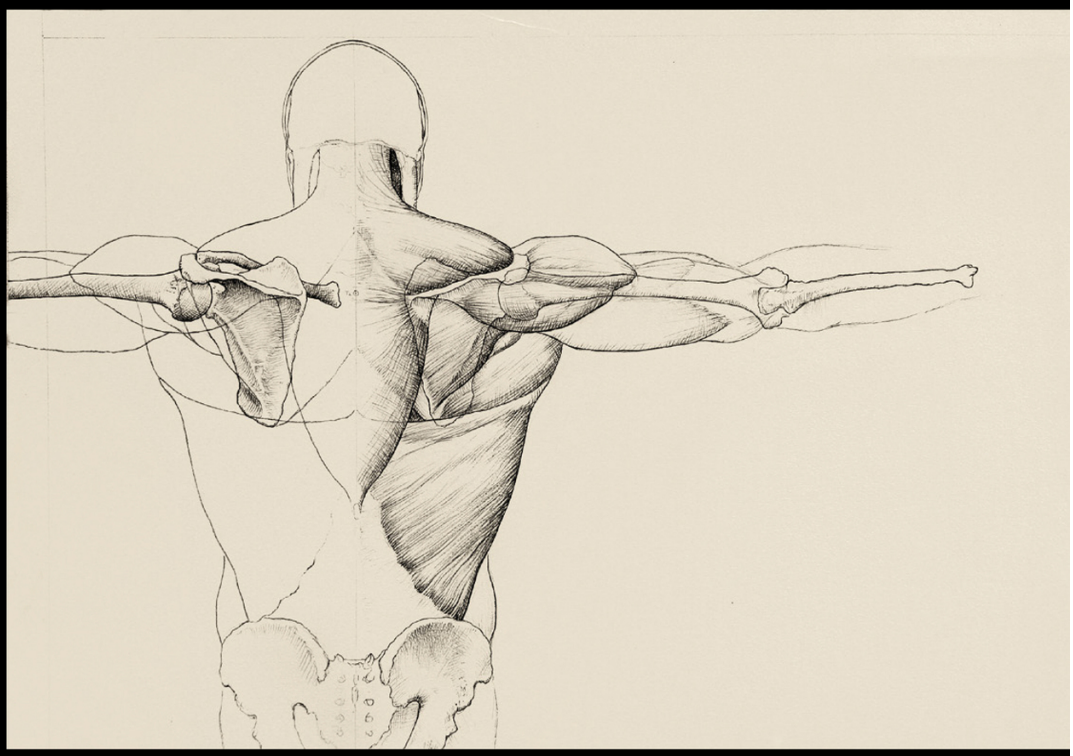
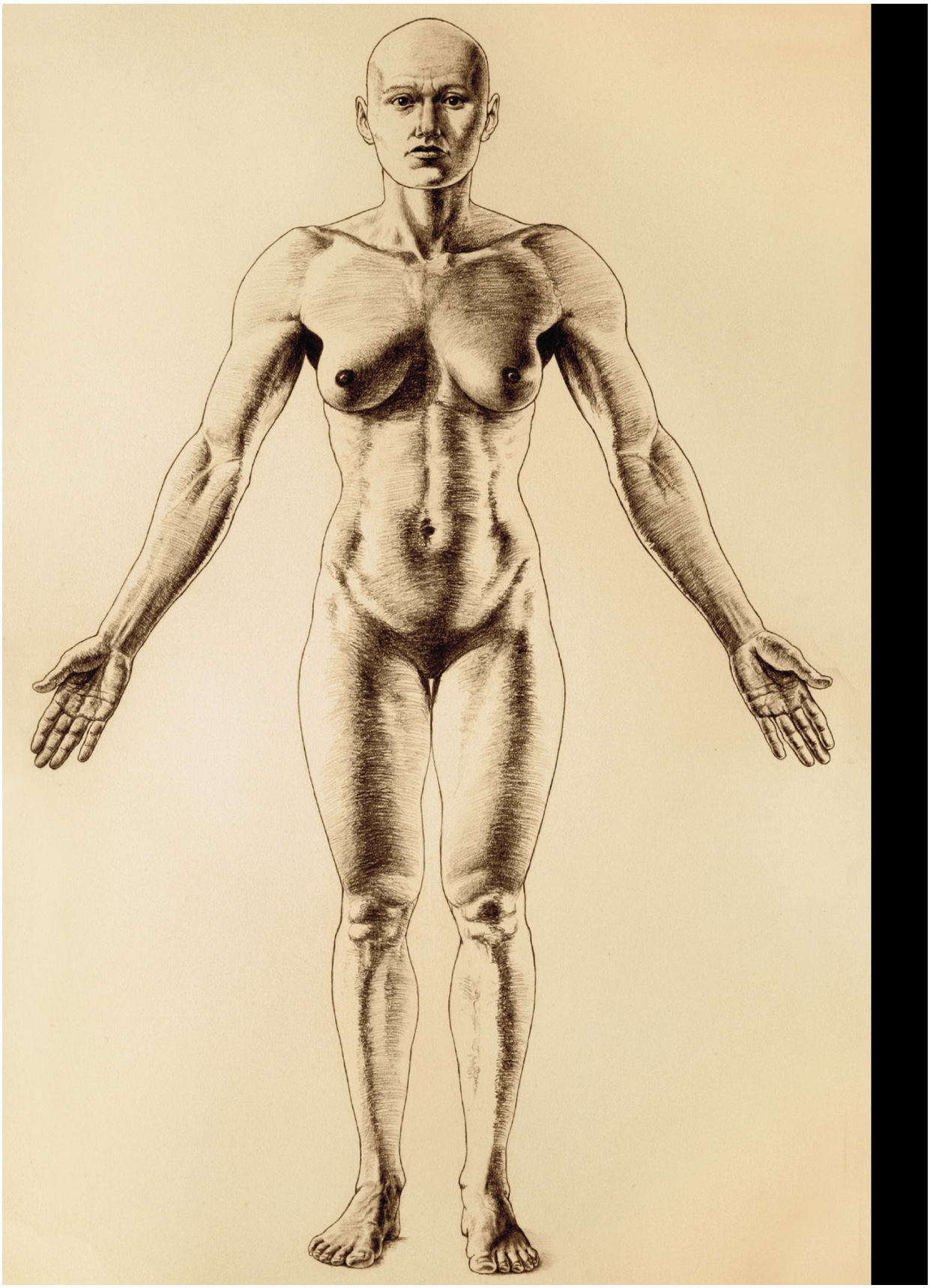


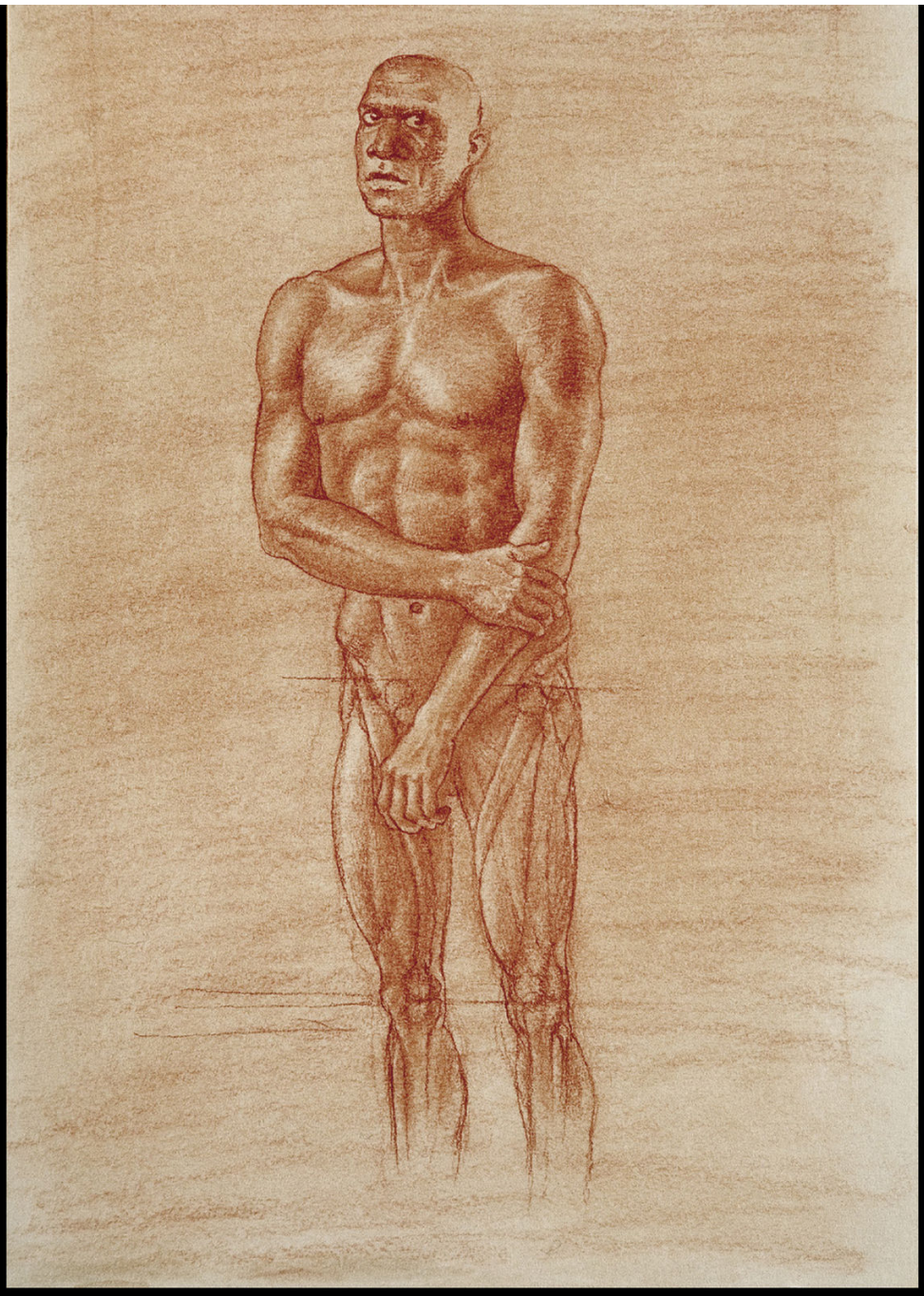
Homo neanderthalensis male, based on a skeleton from the French site of La Ferrassie. Graphite on board.

Opposite:
Homo neanderthalensis male, based on a skeleton from the French site of La Ferrassie. Graphite drawings and anatomical notes, copied on acetate and superimposed, giclee printed, with added ink and acrylic paint.

Homo neanderthalensis male hand skeleton, from the French site of La Ferrassie. Graphite on acrylic-washed board.

Opposite:
Homo neanderthalensis female figure, based on remains from the French site of La Ferrassie and Spanish site of Gibraltar. Graphite on paper, digitally colored.



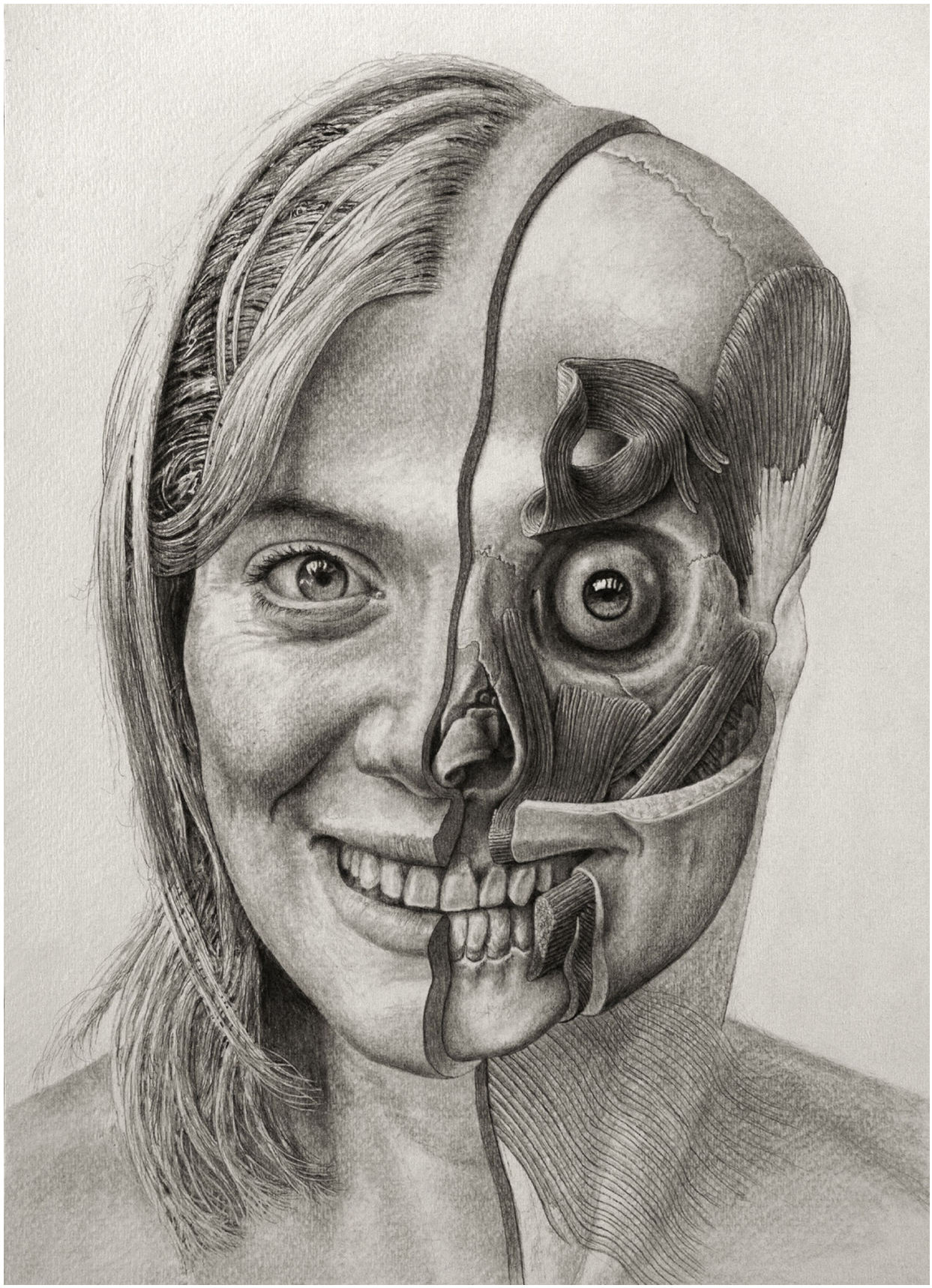


Modern *Homo sapiens* male figure. Red chalk on board.

Opposite:
Homo sapiens female figure, based on a skeleton from Předmostí in Czechoslovakia. Graphite on paper, digitally colored.

Homo sapiens skull from the Qafzeh site in Israel. Graphite on paper.

Opposite:
Homo sapiens anatomy of a smile. Graphite on paper.

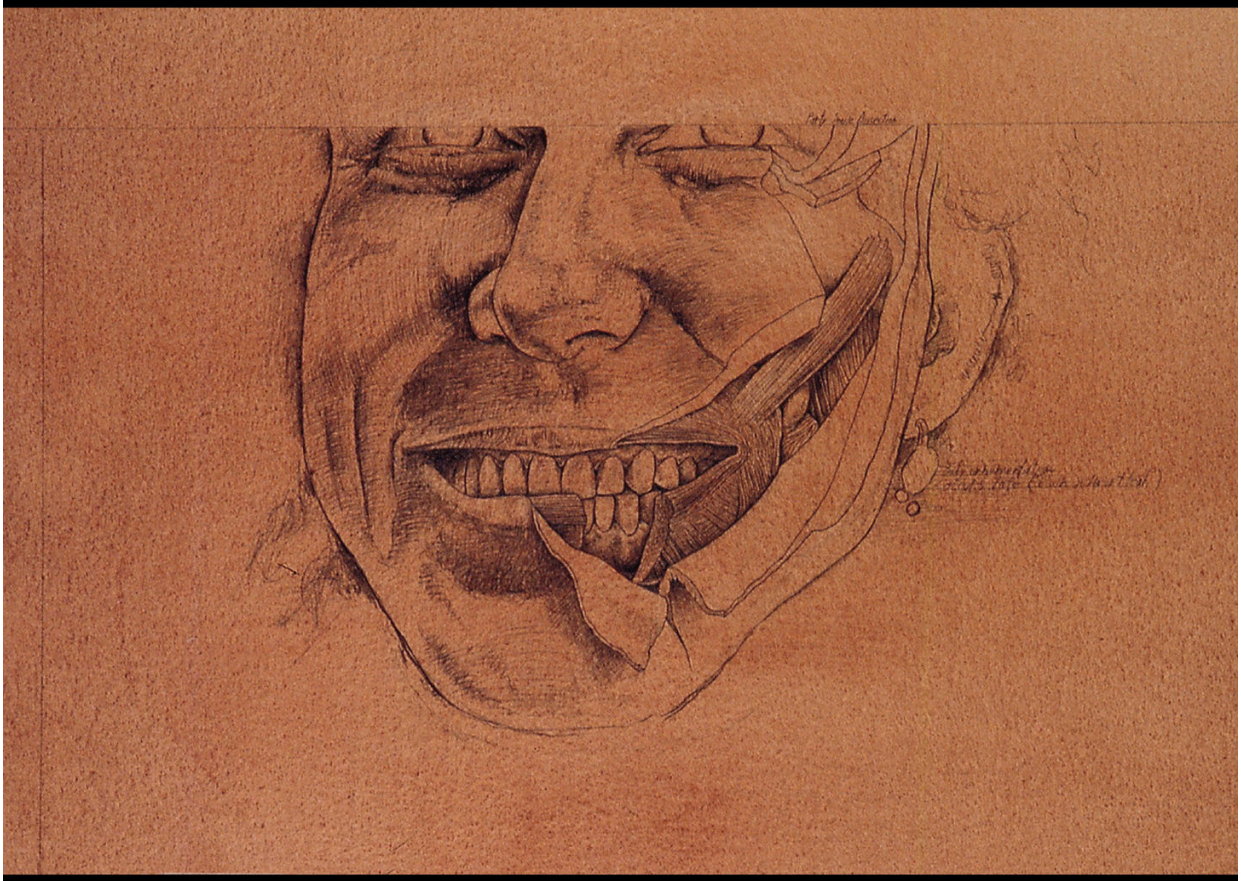


"Mike," modern ***Homo sapiens*** elderly male. Graphite on paper.

Opposite:
"Blythe," modern ***Homo sapiens*** female in her first year. Graphite on acrylic-washed board.

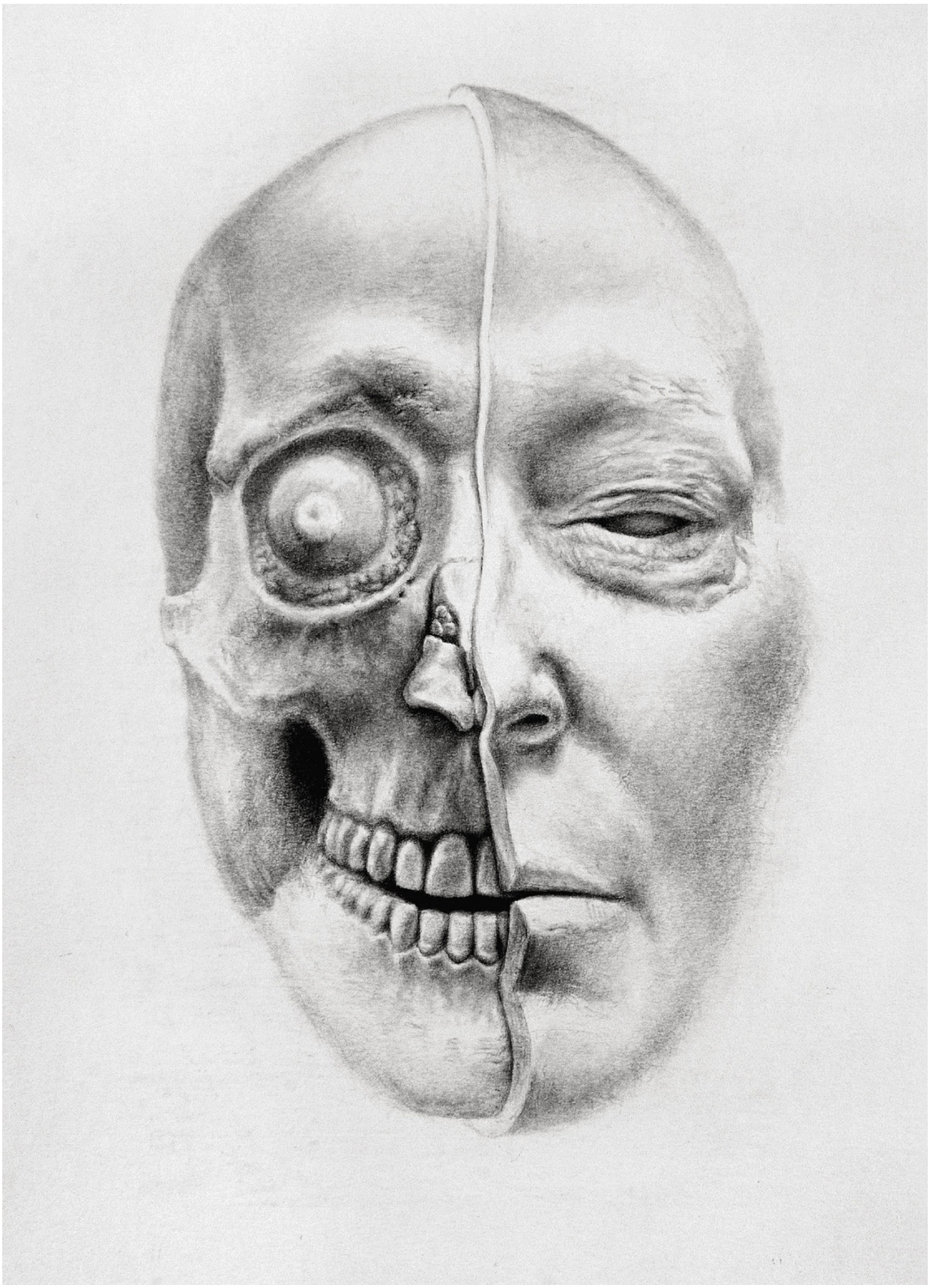
"Skin," modern ***Homo sapiens*** elderly male. Death mask rolled across copier window, with added acrylic paint.

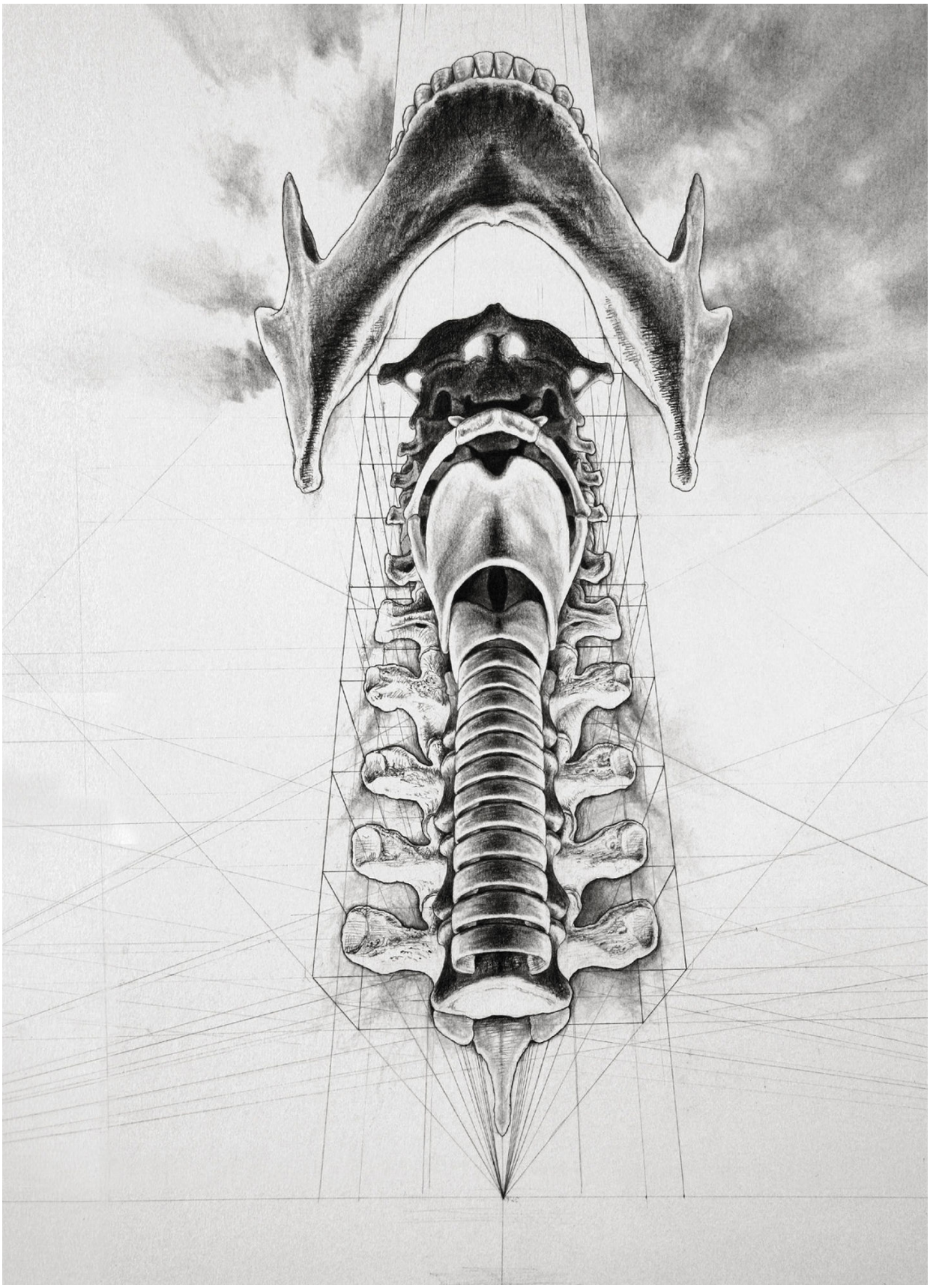
Opposite:
"Party Smile Dissection," modern ***Homo sapiens*** female. Graphite on acrylic-washed board.

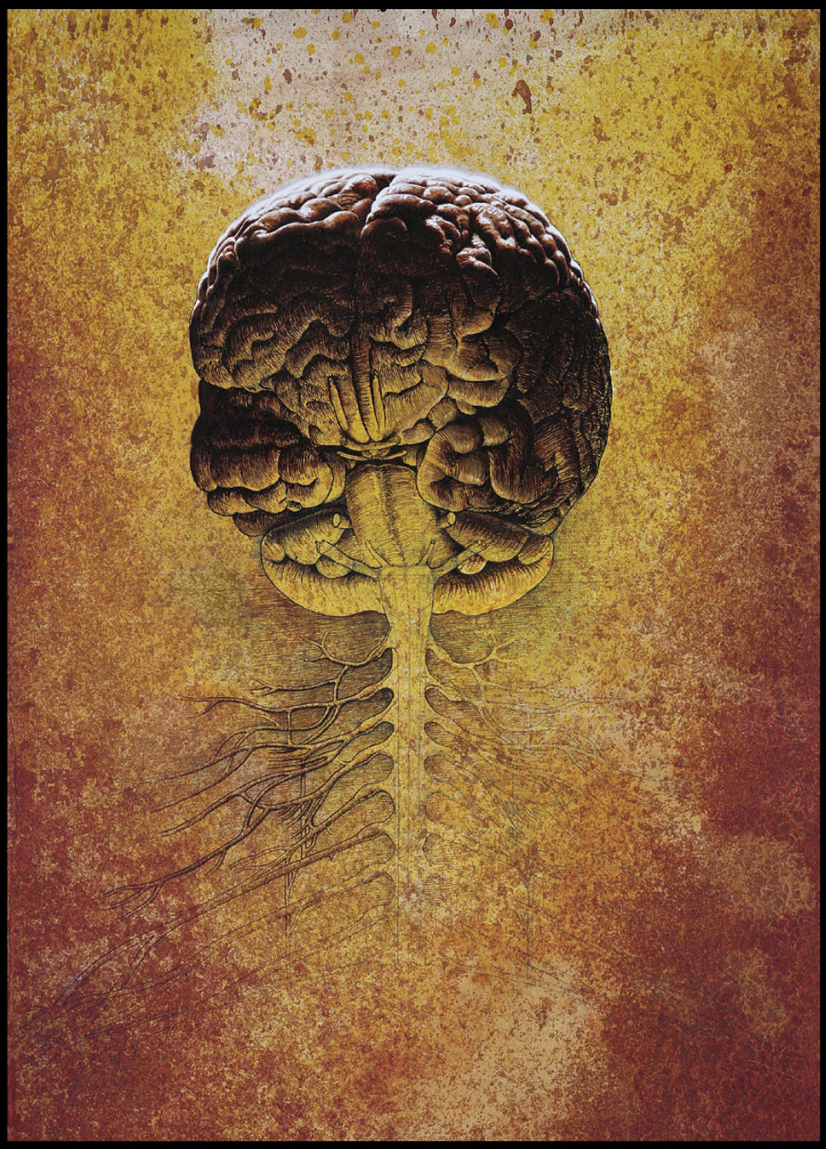


"View from the brain," ***Homo sapiens*** sphenoid bone.
Graphite on board.

Opposite:
Homo sapiens elderly female, drawn from dissection cast.
Graphite on paper.





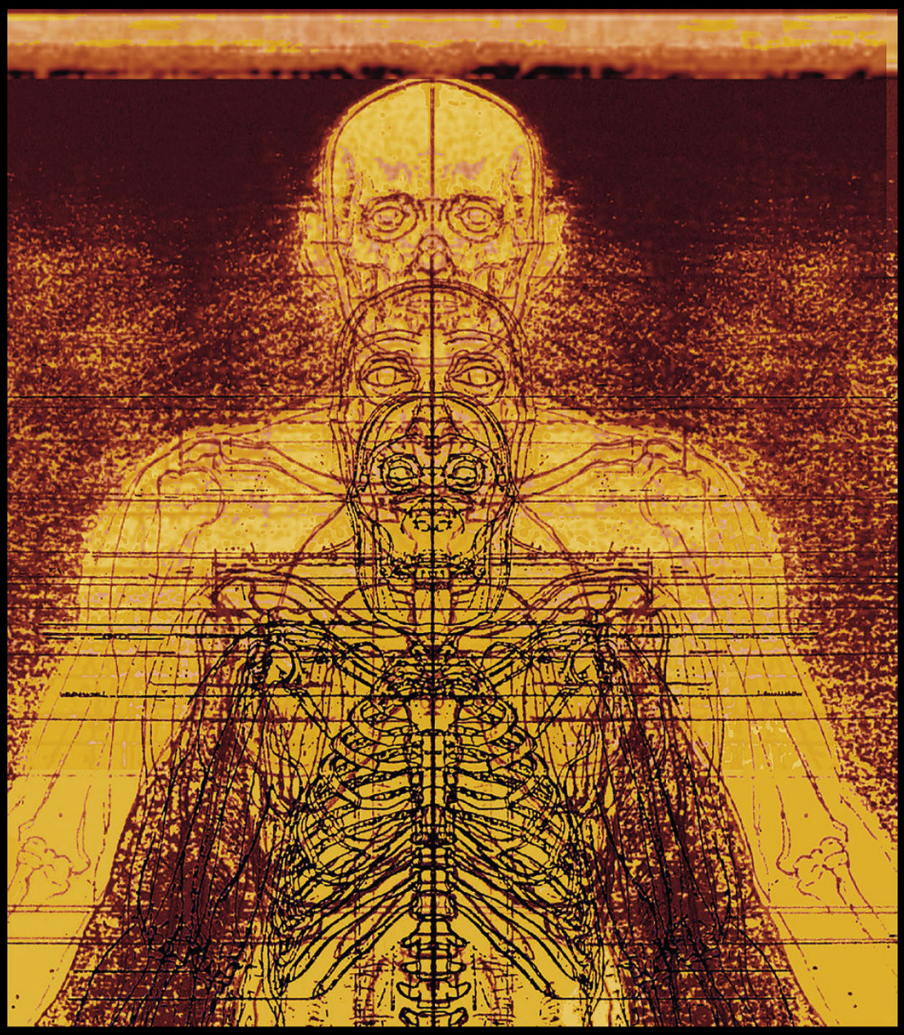


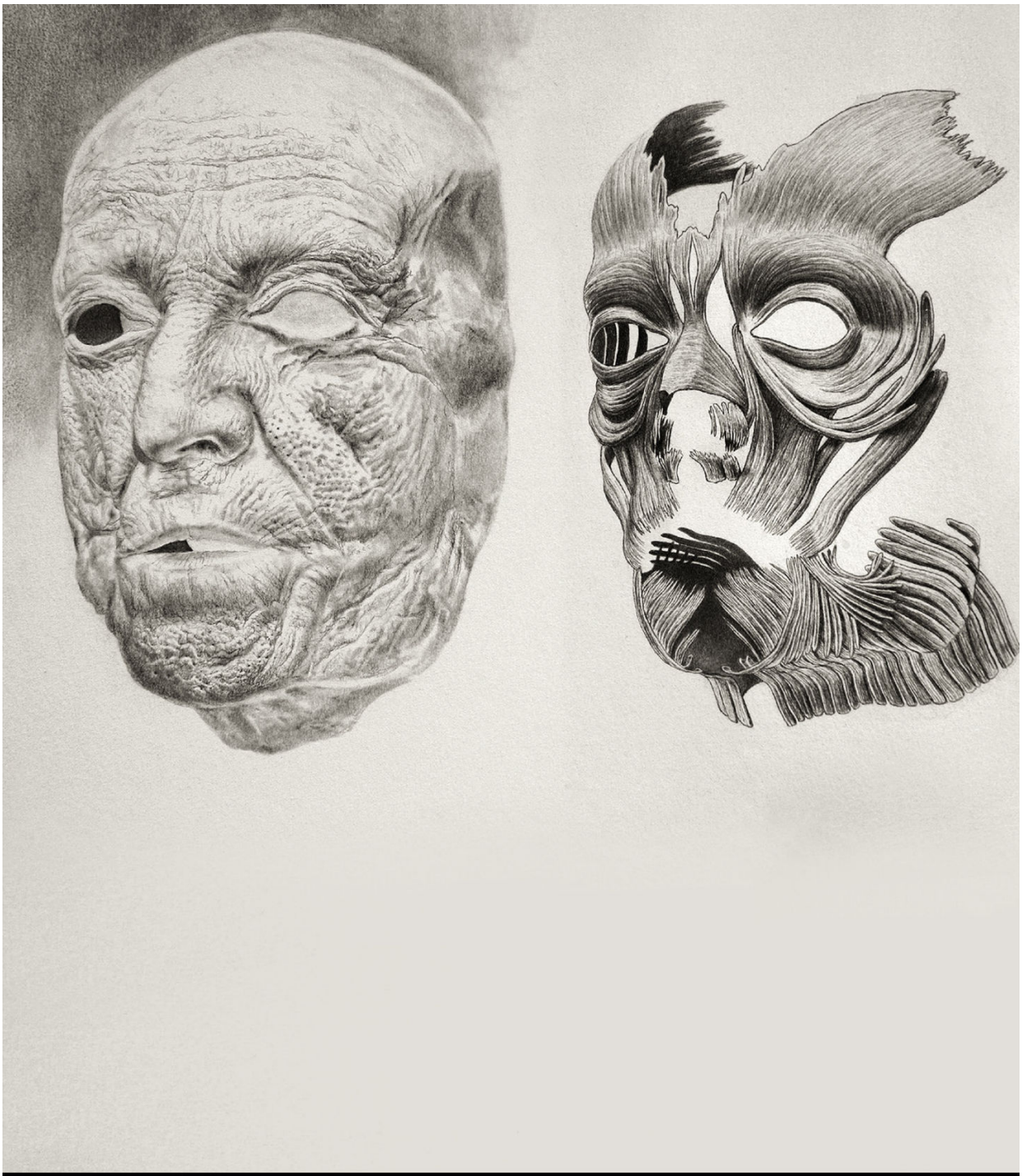
Homo sapiens brain and spinal cord with cervical nerves. Pen and ink with graphite and acrylic on board.

Left:
"Tower of Babble," *Homo sapiens,* bones and cartilage of the neck and vocal tract. Graphite on board.

Homo sapiens right foot. Graphite on paper.

Opposite:
"Electric Ladyland," anatomical outlines of ***Homo sapiens, Homo erectus,*** and ***Australopithecus afarensis*** females. Graphite drawings, digitally colored and superimposed.





Modern *Homo sapiens* elderly male face, deep to superficial anatomy. Graphite on board.

ACKNOWLEDGMENTS

This book was only possible with the help and encouragement of others. It is a bit overwhelming to try to assemble the names of all who have helped in various ways with this twenty-seven-year project. I'm sure to leave someone out, and to you I apologize in advance.

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David Zlotky made high-quality prints of digital work on watercolor paper, so they could be taken further down the road with ink and paint.

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Lost Anatomies' journey from art collection to book began when my daughter Blythe told me about *Beautiful Brain* by Abrams Books. I found in its artwork and essays an aesthetic I love. I am very grateful to Eric Himmel at Abrams for making the process of bringing this book to fruition such a human one. I'm grateful also for the inspired design work of Darilyn Carnes, the production management of Anet Sirna-Bruder, and the copyediting of Jane Bobko. The organizational skills of Connor Leonard and Alicia Tan were crucial to the book.

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John Gurche

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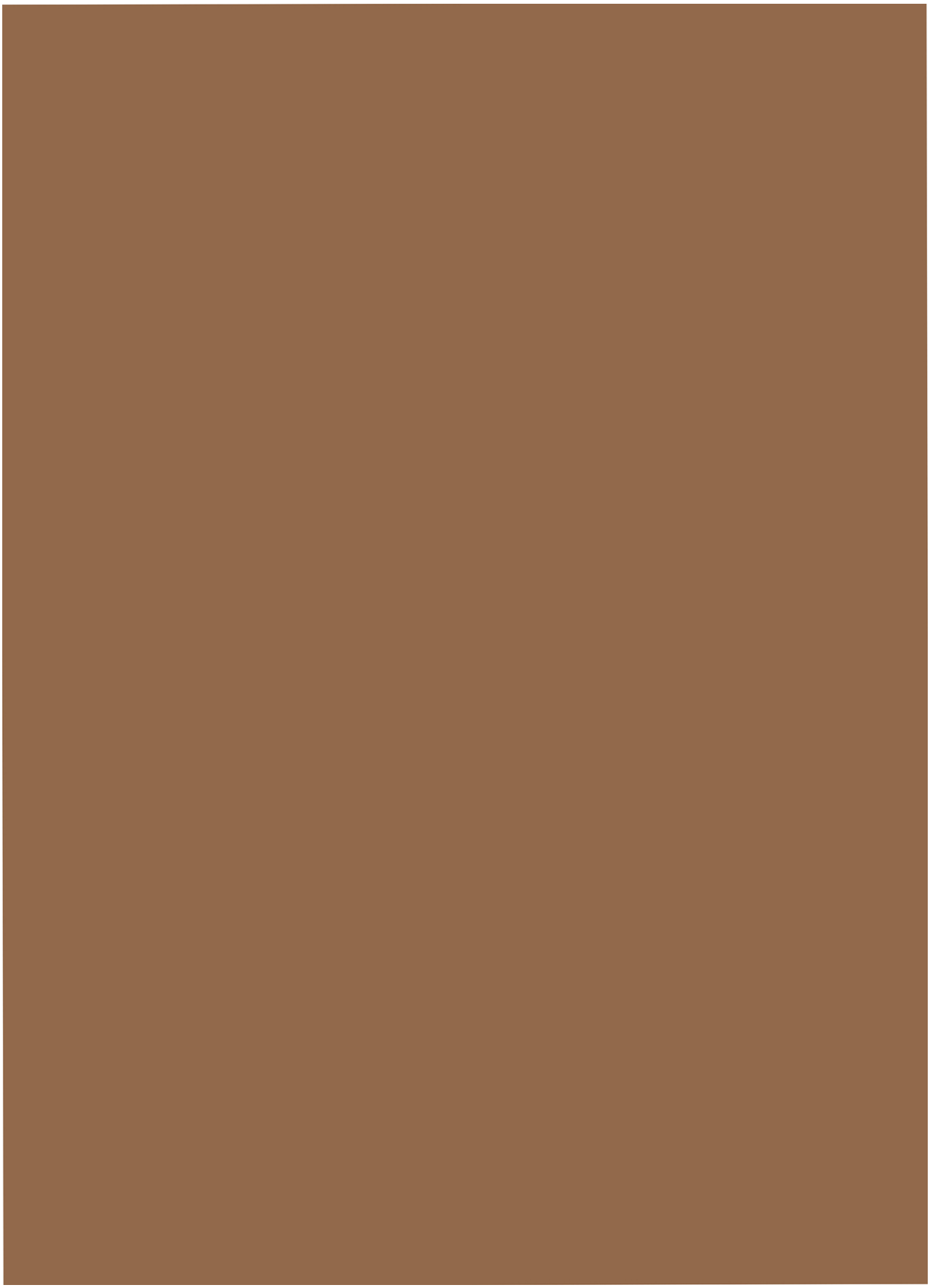

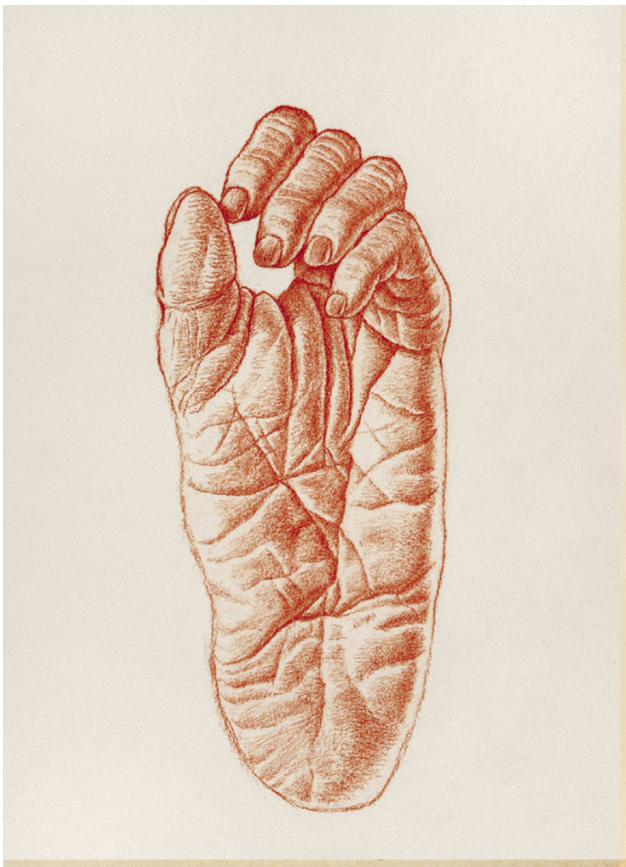

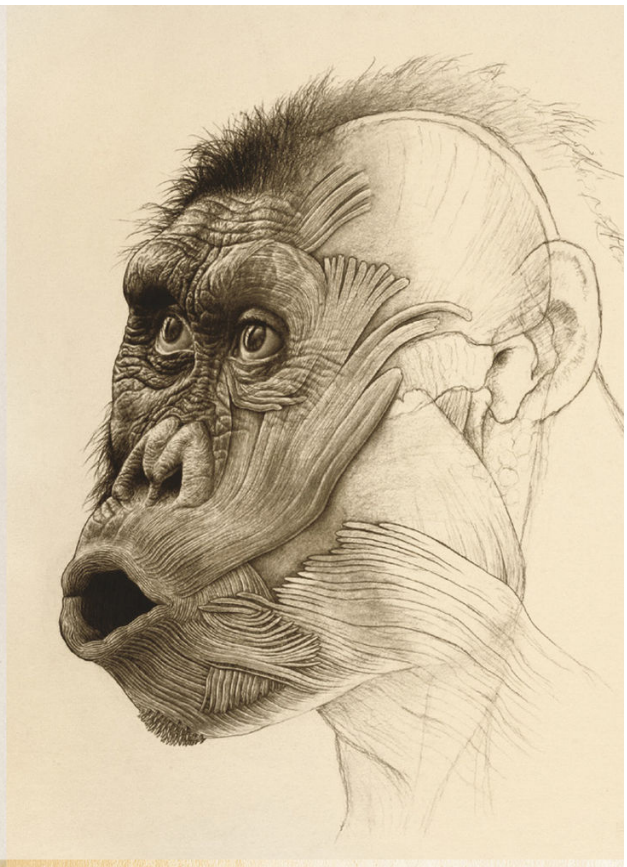

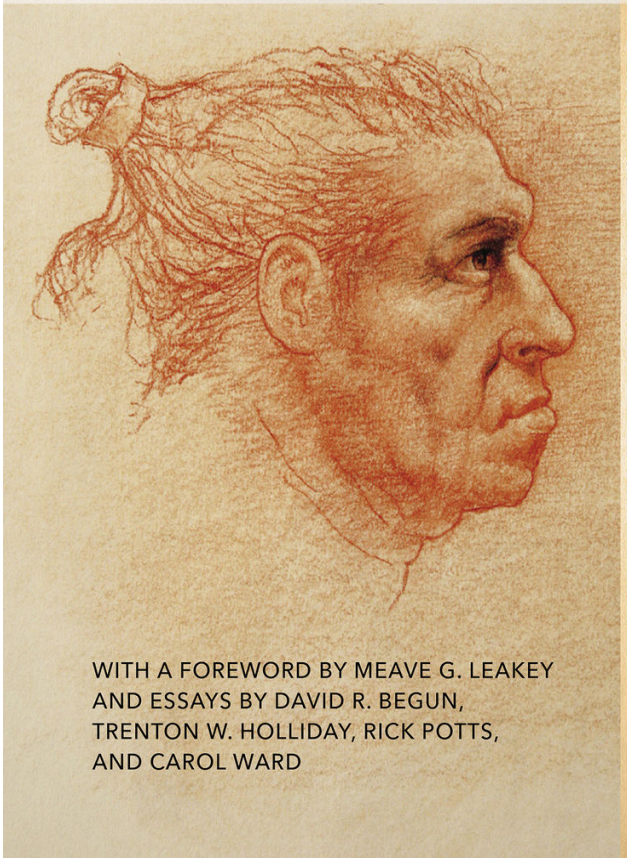

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AND ESSAYS BY DAVID R. BEGUN,
TRENTON W. HOLLIDAY, RICK POTTS,
AND CAROL WARD