It's Anthony Caro season in Europe. An overview of his career, at the Museo Correr through Oct. 27, is a highlight of the 55th Venice Biennale. In London, through Friday, the Gagosian Gallery is showing a group of his recent works, while an enormous, even more recent sculpture dominated a gallery in the Royal Academy Summer Exhibition. Mr. Caro, who will turn 90 next year, shows no signs of slowing down. "I don't have any hobbies," he quipped at a panel discussion a few years ago. "I just focus on making sculpture."

Mr. Caro has been focusing on making sculpture since the mid-1950s, when his thickset expressionist figures in bronze first attracted attention. Despite early praise for these works, he became dissatisfied. "I didn't want to make imitation human beings," he recalls. After his first trip to the U.S. in 1959 and the suggestion from the critic Clement Greenberg that "If you want to change your art, change your habits," Mr. Caro abandoned modeling and casting to work directly in steel, employing found elements in a new kind of three-dimensional collage, building on the "new tradition" of sculpture developed by Pablo Picasso, Juli González and David Smith.
But unlike his predecessors' work, Mr. Caro's drawinglike constructions were painted in clear colors and spread horizontally. Most were placed directly on the ground without the traditional base or plinth; they were as "real"—Mr. Caro's word—as anything else we encountered but also completely unfamiliar. By the early 1960s, these unprecedented works made him known internationally and began to influence his peers everywhere. But Mr. Caro has never settled for what he knows he can do. Over the past half-century, he has regularly challenged himself, making—among other things—confrontational structures in unpainted steel, massive enclosed volumes, and even abstract narrative sequences, improvising on such themes as the Trojan War and the Last Judgment.

"Solitude' (2012.) Courtesy Gagosian Gallery/Barford Sculptures Ltd.

Although Mr. Caro's base remains London, he is, in every sense, an international figure. He has had major exhibitions throughout Asia and Europe and, on this side of the Atlantic, a full-dress retrospective in 1975 at the Museum of Modern Art, a synoptic overview of his career in "Caro on the Roof" at the Metropolitan Museum of Art in 2011 and, last fall, a survey of intimate-scale works at the Yale Center for British Art in New Haven, Conn. In 2008, a permanent installation he created for a 13th-century church in northern France was dedicated.

"Caro at the Museo Correr" was curated by Gary Tinterow, director of the Houston Museum of Fine Arts, and Gabriella Belli. The show consists in the main of 12 major sculptures from 1962 to 2012. These range from such "signature" works as the gleaming aluminum "Hopscotch" (1962), its intersecting horizontals and verticals seeming to hover and float, to the more recent boxy steel and wood "Duccio Variations I" (1999-2000), based on a painting in London's National Gallery. The most recent works, constructed of larger elements than previously, disposed with even greater expansiveness and assurance, are evidence that, at 89, Mr. Caro is still continually reinventing himself.

"The Correr show was about choosing sculptures to be placed in rather constricted, constrained spaces, so that's the reason I was interested in taking up that challenge," Mr. Caro says. We're having tea in a sunny room across the courtyard from the large, tool- and sculpture-filled
workspace, a former piano factory, where he spends much of his time. Subtly colored works by Sheila Girling, Mr. Caro's wife and a recognized painter in her own right, hang over a long table; a chunky recent Caro is visible through a wide doorway. "What I was interested in was that each work had its own space, so it wasn't just about the work, but about the work fitting into the space."

Because the installation at the Correr obliges viewers to concentrate on one sculpture at a time, the show offers a tutorial in what makes a Caro a Caro: his "syntax" (the critic Michael Fried's term) of how the elements touch, the intervals between them, their similarities and differences, his use of color and frequent defiance of gravity.

His undiminished powers are attested to by the 10 generously scaled, stellar sculptures from the 2012 "Park Avenue Series" at Gagosian. (Another is on view in the Correr exhibition.) The largest is about 25 feet long, the smallest roughly 10 feet square. Some, such as the unpredictable "Wandering," stretch like bridges, diagramming and activating an expanse of space. Robust bars and gently curved lengths of thick pipe move energetically outward with assertive gestures. Others, such as the more contained "Solitude," pull themselves upward into denser but no less unexpected configurations.

The series evolved from a project conceived several years ago for the median strips on Park Avenue in New York. Mr. Caro envisioned three monumental, block-long "trestles." Of necessity, given the sculptures' projected size, he made quarter-scale models. But escalating costs eventually forced abandonment of the project, so Mr. Caro sliced and otherwise transformed the leftover models into "Park Avenue Series," some of his most potent, animated work to date.

Fragments of the "trestles" survive as long, horizontal brush-strokelike forms, creating permeable but mysterious interior volumes punctuated by widely dispersed, heavy steel elements. More place than object, these vast sculptures keep us moving around them, seeking a viewpoint from which their elusive logic and "secret" inner configurations will reveal themselves.

"I was asked what the best way to see these sculptures was," Mr. Caro comments, "and I said 'Walk. Walk. The length of them is important.'"

The works all have an astonishing presence—some are as imposing as locomotives. This is sculpture in the Grand Manner, as confident, ambitious and monumental as the masterworks of premodern art. But within each piece there are smaller, more intimate events that demand—reward—close attention. The "Park Avenue Series" possesses both spontaneity and a sense of inevitability, yet their apparent grace and ease were hard won.

"They went through big changes, when you take out everything extra," Mr. Caro says. "But I think that always happens." (He has described his creative process as putting things together and then "taking away everything that isn't necessary to the sculpture.")
Mr. Caro's London studio is full of works in progress. A group of young sculptors directed by his long-time studio assistant, Patrick Cunningham, acts as extensions of the artist's limbs, trying out placements and combinations of parts—and vying to use a miniature fork lift to manipulate large pieces of steel.

Unlike many sculptors, Mr. Caro doesn't normally make preliminary studies or maquettes, but works full scale. "I'm never comfortable working on something that has to be imagined bigger or different," he says.

This made the Park Avenue project a particular challenge. Because of its size and location, he had to alter his usual method.

"What I would have liked to have done," Mr. Caro says, "is to make the sculptures and then change them at the real scale."

These days, Mr. Caro's restless invention is evident in a group of large sculptures incorporating planes of colored Plexiglas. He seems most fascinated by the way its transparency offers him new ways of embracing space when combined with steel and weathered wood, or with stone. "I don't like doing the same thing over and over again; it's too boring," he explains.

Perhaps Mr. Caro's recent sculpture is so assured and magisterial because his view is so broad. "I wonder about things like rhythm, and it seems to me that many of these things are duplicated in all the arts—poetry, music, architecture, ballet, sculpture. The forms are different, but they speak to each other. I can't be specific—but they do seem alike, but in different languages."

The "Caro season" in Venice and London affirms how eloquently, over six decades, Mr. Caro has spoken and continues to speak his own chosen language.