Balsam Range is ripe for broader recognition. If you’ve not heard, or even heard of, this honored five-man bluegrass band named for the slice of the Blue Ridge Mountains that stretches out near their North Carolina home base, their latest album, “Aeonic” (Mountain Home Music Company), released on Friday, will be an ear opener.

In the world of bluegrass music, there have always been performers, whether determinedly tradition-minded or more adventurous and modern in musical focus, who have been admired for dazzling performances and instrumental and vocal prowess, but only within the sturdy but circumscribed field itself. Those who have leaped to greater, broader prestige and popularity—Flatt & Scruggs, Alison Krauss, Ricky Skaggs, the Del McCoury Band—have all demonstrated musical mastery in spades but contributed distinctive ways to mesh the traditional and up-to-date while actively reaching out to the wider audiences for country music, Americana, folk, or pop. Wider commercial success, prime-time television, larger performance venues and, in every one of those examples, multiple Grammy Award nominations followed.

Founded in 2007, Balsam Range is now showing itself to be quite capable of following in those footsteps. The band won the top Entertainer of the Year honor at the 2018 International Bluegrass Music Awards for a second time, and it had previously racked up Vocal Group of the Year, as well, this being an outfit with multiple members who take strong leads in the singing, most notably fiddle player Buddy Melton—Male Vocalist of the Year in 2014 and 2018.

‘Aeonic’ by Balsam Range Review: Bluegrass That’s Ready to Grow

The members had all honed their skills in previous stands—Mr. Melton with Doc Watson and the Americana band Jubal Foster; bass and dobro player Tim Surrett with the legendary Southern Gospel group the Kingsmen Quartet and Ralph Stanley; and Grammy-winning banjoist Marc Pruett with Ricky Skaggs’s band Kentucky Thunder. Mandolin ace Darren Nicholson and guitarist Caleb Smith have been no less revered in the field. Their grounding in classic bluegrass was unquestionable and many of their earliest recordings leaned on Bill Monroe songs, lest anyone miss the fact.

That would not be Balsam Range’s ultimate direction. By 2012, its breakthrough IBMA Album of the Year, “Papertown,” was built on everything from an Allman Brothers-influenced turn on the blues standard “One Way Out” to a Roy Acuff number, and songs by top contemporary Nashville songwriters ranging from Buddy and Julie Miller to Chris Stapleton and Mike Henderson as well as Mr. Melton’s sometime side-project duo partner, Milan Miller. The band’s April 2018 album, “Mountain Overture,” underscored the quintet’s increasing attraction to lusher pop sounds, as the band revisited some of its best-known songs with new orchestrations featuring the Atlanta Pops Orchestra Ensemble.

“Aeonic”—its very title taking note of Balsam Range’s unusually stable, long-lasting member lineup—pushes the band’s eclectic choices further. There are songs from indie rock-oriented singer-songwriters such as Ray LaMontagne (“Hobo Blues”) and the Paul Thorn-William Maddox team (“Angel Too Soon”), as well as from the country duo Adam and Shannon Wright (“The Girl Who Invented the Wheel”). The album closer is a driving bluegrass turn on George Harrison’s Beatles tune “If I Needed Someone.”

Besides the classic banjo-fiddle-mandolin-guitar-bass (and occasional dobro) lineup, the strikingly traditional aspect of this set is the group’s predilection for blues (a strong element in bluegrass music’s earliest days) and the blues sensibility—sometimes hurt, sometimes jubilantly, assuredly past hurt—that goes with it. Many of these songs depict and reflect undisguised desperation, including the blues numbers and “Help Me to Hold On,” the extraordinary, gospel-tinged prayer as a cry for help (from the pens of Milan Miller and Thomm Jutz) sung movingly by Mr. Melton. By contrast, “The Girl Who Invented the Wheel” is the comic story of a man so effectively dumped that he just has to salute, ebulliently, the woman who did that so well.

The modern vocal approach of all of this band’s singers, which avoids slavish mimicking of old-school high, lonesome vocals, plus the spacious quality of the sound production throughout, makes it very clear this is an album for 2019, not 1949. The musical approach and the material both make this a record that should satisfy a wide audience. It’s up to the band, of course, whether it wants to extend its reach as others have before.

—Mr. Mazor, based in Nashville, reviews country and roots music for the Journal.