NEWS for R version 3.6.1 (2019-07-05)



CHANGES IN R 3.6.1

INSTALLATION on a UNIX-ALIKE:

- The default detection of the shell variable `libNN` is overridden for derivatives of Debian Linux, some of which have started to have a '`/usr/lib64`' directory. (E.g. Ubuntu 19.04.) As before, it can be specified in '`config.site`'.

UTILITIES:

- `R CMD config` knows the values of `AR` and `RANLIB`, often set for LTO builds.

DEPRECATED AND DEFUNCT:

- The use of a character vector with `.Fortran()` is formally deprecated and gives a non-portability warning. (It has long been strongly discouraged in 'Writing R Extensions'.)

BUG FIXES:

- On Windows, GUI package installation via `menuInstallPkgs()` works again, thanks to Len Weil's and Duncan Murdoch's PR#17556.
- `R CMD check` on `data()` fixing PR#17558 thanks to Duncan Murdoch.
- `quasi(*,variance = list(..))` now works more efficiently, and should work in all cases fixing PR#17560. Further, `quasi(var = mu(1-mu))` and `quasi(var = "mu ^ 3")` now work, and `quasi(variance = "log(mu)")` now gives a correct error message.
- Creation of lazy loading database during package installation is again robust to Rprofile changing the current working directory (PR#17559).
- `boxplot(y ~ f,horizontal=TRUE)` now produces correct x- and y-labels.
- `rbind.data.frame()` allows to keep `<NA>` levels from factor columns (PR#17562) via new option `factor.exclude`.
  Additionally, it works in one more case with matrix-columns which had been reported on 2017-01-16 by Krzysztof Banas.
- Correct messaging in C++ pragma checks in **tools** code for `R CMD check`, fixing PR#17566 thanks to Xavier Robin.
- print()ing and auto-printing no longer differs for `functions` with a user defined `print.function`, thanks to Bill Dunlap's report.

- On Windows, `writeClipboard(..,format = <n>)` now does correctly pass `format` to the underlying C code, thanks to a bug report (with patch) by Jenny Bryan.
- `as.data.frame()` treats 1D arrays the same as vectors, PR#17570.
- Improvements in `smoothEnds(x,*)` working with `NA`s (towards `runmed()` working in that case, in the next version of R).
- `vcov(glm(<quasi>),dispersion = *)` works correctly again, fixing PR#17571 thanks to Pavel Krivitsky.
- `R CMD INSTALL` of binary packages on Windows now works also with per-directory locking.
- `R CMD INSTALL` and `install.packages()` on Windows are now more robust against a locked file in an earlier installation of the package to be installed. The default value of option `install.lock` on Windows has been changed to `TRUE`.
- On Unix alikes (when `readline` is active), only expand tilde (`~`) file names starting with a tilde, instead of almost all tildes.
- In R documentation ('`*.Rd`') files, '`\item [..]`' is no longer treated specially when rendered in LaTeX and hence pdf, but rather shows the brackets in all cases.



CHANGES IN R 3.6.0

SIGNIFICANT USER-VISIBLE CHANGES:

- Serialization format version 3 becomes the default for serialization and saving of the workspace (`save()`, `serialize()`, `saveRDS()`, `compiler::cmpfile()`). Serialized data in format 3 cannot be read by versions of R prior to version 3.5.0. Serialization format version 2 is still supported and can be selected by `version = 2` in the save/serialization functions. The default can be changed back for the whole R session by setting environment variables `R_DEFAULT_SAVE_VERSION` and `R_DEFAULT_SERIALIZE_VERSION` to `2`. For maximal back-compatibility, files '`vignette.rds`' and '`partial.rdb`' generated by `R CMD build` are in serialization format version 2, and resave by default produces files in serialization format version 2 (unless the original is already in format version 3).
- The default method for generating from a discrete uniform distribution (used in `sample()`, for instance) has been changed. This addresses the fact, pointed out by Ottoboni and Stark, that the previous method made `sample()` noticeably non-uniform on large populations. See PR#17494 for a discussion. The previous method can be requested using `RNGkind()` or `RNGversion()` if necessary for reproduction of old results. Thanks to Duncan Murdoch for contributing the patch and Gabe Becker for further assistance.
  The output of `RNGkind()` has been changed to also return the 'kind' used by `sample()`.

NEW FEATURES:

- `Sys.setFileTime()` has been vectorized so arguments `path` and `time` of length greater than one are now supported.
- `axis()` gets new option `gap.axis = NA` for specifying a multiplication factor for the minimal "gap" (distance) between axis labels drawn. Its default is `1` for labels *parallel* to the axis, and `0.25` for perpendicular ones.
  Perpendicular labels no longer overlap, fixing bug PR#17384.
- The default method of `plot()` gains new arguments `xgap.axis = NA` and `ygap.axis = NA` to be passed to the x– and y– `axis(..,gap.axis=*)` calls.

- `removeSource()` now works not only for functions but also for some language objects.
- `as.call()`, `rep.int()`, `rep_len()` and `nchar()` dispatch internally.
- `is(object,class2)` looks for `class2` in the calling namespace after looking in the namespace of `class(object)`.
- `extendrange(..,f)` with a length-2 `f` now extends separately to the left and the right.
- `lengths()` dispatches internally to S4 methods.
- `download.file()` on Windows now uses `URLdecode()` to determine the file extension, and uses binary transfer (`mode = "wb"`) also for file extension '`.rds`'.
  The help page for `download.file()` now contains the same information on all platforms.
- Setting '`C`' locale for collation *via* environment variables `LC_ALL` and `LC_COLLATE` and *via* a call to `Sys.setlocale()` now takes precedence over environment variable `R_ICU_LOCALE`.
- There is a new function, `nullfile()`, to give the file name of the null system device (e.g., '`/dev/null`') on the current platform.
- There are two new options, `keep.parse.data` and `keep.parse.data.pkgs`, which control whether parse data are included into sources when `keep.source` or `keep.source.pkgs` is `TRUE`. By default, `keep.parse.data.pkgs` is now `FALSE`, which changes previous behavior and significantly reduces space and time overhead when sources are kept when installing packages.
- In `rapply(x,..)`, `x` can also be "list-like" and of length $\geq 2^{31}$.
- `trimws()` gets new optional `whitespace` argument, allowing more extensive definitions of "space", such as including Unicode spaces (as wished in PR#17431).
- `weighted.mean()` no longer coerces the weights to a double/numeric vector, since `sum()` now handles integer overflow. This makes `weighted.mean()` more polymorphic and endomorphic, but be aware that the results are no longer guaranteed to be a vector of type '`double`'.
- When loading namespaces, S3 method registrations which overwrite previous registrations are now noted by default (using `packageStartupMessage()`).
- `compiler::cmpfile()` gains a `version` argument, for use when the output file should be saved in serialization format 2.
- The axis labeling in the default method of `pairs()` may now be toggled by new options `horOdd` and `verOdd`.
- (Not Windows nor macOS.) Package **tcltk** now supports an environment variable `R_DONT_USE_TK` which if set disables Tk initialization. This is intended for use to circumvent errors in loading the package, e.g. with recent Linux running under an address sanitizer.
- The `numeric` method of `all.equal()` gets optional arguments `countEQ` and `formatFUN`. If `countEQ` is true, the mean error is more sensible when many entries are **eq**ual.
- `outer(x,y,FUN = "*")` is more efficient using `tcrossprod(u,v)` instead of `u %*% t(v)`.
- `vcov(<mlm>)` is more efficient via new optional arguments in `summary.mlm()`.
- The default method of `summary()` gets an option to choose the *kind* of `quantile()`s to use; wish of PR#17438.
- Fitting multiple linear models *via* `lm()` does work with *matrix* offsets, as suggested in PR#17407.

- The new functions `mem.maxVSize()` and `mem.maxMSize()` allow the maximal size of the vector heap and the maximal number of nodes allowed in the current `R` process to be queried and set.
- `news()` gains support for '`NEWS.md`' files.
- An effort has been started to have our reference manuals, i.e., all help pages. show platform-independent information (rather than Windows or Unix-alike specifics visible only on that platform). Consequently, the Windows version of `X11()` / `x11()` got identical formal arguments to the Unix one.
- `sessionInfo()$running` has been factored out in a new variable `osVersion`.
- `slice.index()` now also works for multi-dimensional margins.
- `untar()` used with an external `tar` command assumes this supports decompression including `xz` and automagically detecting the compression type. This has been true of all mainstream implementations since 2009 (for GNU `tar`, since version 1.22): older implementations are still supported *via* the new argument `support_old_tars` whose default is controlled by environment variable `R_SUPPORT_OLD_TARS`. (It looks like NetBSD and OpenBSD have 'older' `tar` commands for this purpose.)
- The new function `asplit()` allow splitting an array or matrix by its margins.
- New functions `errorCondition()` and `warningCondition()` provide a convenient way to create structured error and warning objects.
  `.Deprecated()` now signals a warning of class `"deprecatedWarning"`, and `.Defunct()` now signals an error of class `"defunctError"`.
- Many 'package not found' errors are now signaled as errors of class `"packageNotFoundError"`.
- As an experimental feature, when `loadNamespace()` fails because the requested package is not available the error is initially signaled with a `retry_loadNamespace` restart available. This allows a calling handler to try to install the package and continue.
- `S3method()` directives in '`NAMESPACE`' can now also be used to perform *delayed* S3 method registration.
- Experimentally, setting environment variable `_R_CHECK_LENGTH_1_LOGIC2_` will lead to warnings (or errors if the variable is set to a 'true' value) when `&&` or `||` encounter and use arguments of length more than one.
- Added `"lines"` and `"chars"` coordinate systems to `grconvertX()` and `grconvertY()`.
- `getOption()` is more efficient notably for the rare case when called with two arguments, from several contributors in PR#17394.
- In `.col(dim)` and `.row(dim)`, `dim` now may also be an integer-valued `"double"`.
- `sQuote()` and `dQuote()` get an explicit `q` argument with obvious default instead of using `getOption("fancyQuotes")` implicitly and unconditionally.
- `unzip()` can list archives with comments and with spaces in file names even using an external `unzip` command.
- Command line completion has a new setting `rc.settings(dots = FALSE)` to remove `...` from the list of possible function arguments.
- `library()` no longer checks packages with compiled code match '`R.version$platform`'. `loadNamespace()` never has, and increasingly the 'canonical name' does not reflect the important characteristics of compiled code.
- The primitive functions `drop()` and `unclass()` now avoid duplicating their data for atomic vectors that are large enough, by returning `ALTREP` wrapper objects with adjusted attributes. R-level assignments to change attributes will also use wrapper objects to avoid duplicating data for larger atomic vectors. R functions like `structure()` and `unname()` will therefore not duplicate data in these settings. Generic vectors as

produced by `list()` are not yet covered by this optimization but may be in due course.

- In `formals()`, `envir` becomes an optional argument instead of being hardwired.
- Instead of signalling an error for an invalid S4 object `x`, `str(x)` now gives a warning and subsequently still shows most parts of `x`, e.g., when slots are missing.
- `gamma(x)` and `lgamma(x)` no longer warn when correctly returning `Inf` or underflowing to zero. This helps maximum likelihood and similar computations.
- `convertColor()` is now vectorized, so a lot faster for converting many colours at once. The new argument `vectorized` to `colorConverter()` ensures that non-vectorized colour converters still work. (Thanks to Brodie Gaslam.)
- `download.file()` and `url()` get new argument `headers` for custom HTTP headers, e.g., allowing to perform basic http authentication, thanks to a patch contributed by Gábor Csárdi.
- File-based connection functions `file()`, `gzfile()`, `bzfile()` and `xzfile()` now signal an error when used on a directory.
- For `approx()`, `splinefun()` *etc*, a new setting `ties = c("ordered",<fun>)` allows skipping the sorting and still treat ties.
- `format(x)` gives a more user friendly error message in the case where no method is defined. A minimal method is provided in `format.default(x)` when `isS4(x)` is true.
- `which(x)` now also works when `x` is a long vector, thanks to Suharto Anggono's PR#17201. **NB**: this may return a double result, breaking the previous guarantee of an integer result.
- `seq.default()` is more careful to return an `integer` (as opposed to `double`) result when its arguments are large and/or classed objects; see comment #9 of Suharto Anggono's PR#17497.
- The `plot()` method for `lm` and `glm` fits, `plot.lm()`, gains a new option `iter.smooth` with a default of `0` for binomial fits, no longer down-weighting when smoothing the residuals.
- `zip()` passes its list of files *via* standard input to the external command when too long for the command line (on some platforms).
- `data()` gains an `overwrite` argument.
- `t.test()` now also returns the standard error (in list component `stderr`).
- `model.matrix(*,contrasts.arg = CC)` now warns about invalid `contrasts.arg`s.
- Performance of `substr()` and `substring()` has been improved.
- `stopifnot()` has been simplified thanks to Suharto Anggono's proposals to become considerably faster for cheap expressions.
- The default 'user agent' has been changed when accessing '`http://`' and '`https://`' sites using '`libcurl`'. (A site was found which caused '`libcurl`' to infinite-loop with the previous default.)
- `sessionInfo()` now also contains `RNGkind()` and prints it when it differs from the default; based on a proposal and patch by Gabe Becker in PR#17535. Also, `RNGversion(getRversion())` works directly.
- `library()` and `require()` now allow more control over handling search path conflicts when packages are attached. The policy is controlled by the new `conflicts.policy` option.
- `barplot()` gets a formula method, thanks to a patch proposal by Arni Magnusson in PR#17521.
- `pmax()` and `pmin(x)` now also work for long vectors, thanks to Suharto Anggono's PR#17533.

- `bxp()` now warns when omitting duplicated arguments.
- New `hcl.colors()` function to provide wide range of HCL-based colour palettes with much better perceptual properties than the existing RGB/HSV-based palettes like `rainbow()`.
  Also a new `hcl.pals()` function to list available palette names for `hcl.colors()`.
  Contributed by Achim Zeileis.
- The default colours for `image()` and `filled.contour()` are now based on `hcl.colors()`.
- The palette-generating functions `rainbow()`, `gray.colors()`, etc. get a new `rev` argument to facilitate reversing the order of colors.
- New `str2lang()` and `str2expression()` as streamlined versions of `parse(text=.,keep.source=FALSE)` allow to abstract typical call constructions, e.g., in `formula` manipulations. (Somewhat experimental)
- Add `update_PACKAGES()` for incrementally updating a package repository index, instead of rebuilding the index from scratch. Thanks to Gabe Becker in PR#17544 for the patch, based on part of his **switchr** package.

INSTALLATION on a UNIX-ALIKE:

- The options selected for the C++ compiler default to the C++11 standard if supported, otherwise to the C++98 standard.
- Visibility macros such as '`C_VISIBILITY`' can now be user-set (including to empty), e.g. in '`config.site`'.
- Macro '`FCLIBS`', which has sometimes been needed on Solaris, has been renamed to '`FCLIBS_XTRA`'.
- Macro '`F77`' is always set to the value of '`FC`', so the latter should be set to user-select the Fortran compiler for both fixed-form and free-form Fortran. In particular, `gfortran` is now the first choice for '`F77`', not `f95`.
  Macros '`FFLAGS`' and '`FCFLAGS`' remain distinct to allow for a compiler which needs a flag to select free- or fixed-form Fortran (most use the source-file extension to choose: '`.f`' is fixed-form and '`.f90`' and '`.f95`' are free-form).
  If only one of them is set, its value is used for both.
- The special-casing of '`CFLAGS`', '`CXXFLAGS`' and '`FFLAGS`' for Intel compilers on Linux has been removed: we do not have recent experience but the generic defaults now chosen are the same as those previously special-cased for '`x86_64`'.
  If necessary, override the defaults on the `configure` command line or in file '`config.site`'.
- Long-untested `configure` support for HP-UX and very old versions of Linux has been removed.
- `configure --with-blas` (without specifying a value) includes OpenBLAS in its search (before ATLAS and a generic BLAS). This follows recent versions of the '`ax_blas`' autoconf macro.
- The `configure` macro '`MAKEINFO`' has been updated to '`TEXI2ANY`'.
- Support for `make install-strip` has been enhanced.

PACKAGE INSTALLATION:

- Source package installation is by default 'staged': the package is installed into a temporary location under the final library directory and moved into place once the installation is complete. The benefit is that partially-installed packages are hidden from other R sessions.
  The overall default is set by environment variable `R_INSTALL_STAGED`. `R CMD INSTALL` has new options '`--staged-install`' and '`--no-staged-install`', and packages can

use the '`StagedInstall`' field in their '`DESCRIPTION`' file to opt out. (That opt-out is a temporary measure which may be withdrawn in future.)
Staged installation requires either '`--pkglock`' or '`--lock`', one of which is used by default.

- The interpretation of source code with extension '`.f`' is changing. Previously this denoted FORTRAN 77 code, but current compilers no longer have a FORTRAN 77 mode and interpret it as 'fixed-form' Fortran 90 (or later where supported) code. Extensions '`.f90`' and '`.f95`' continue to indicate 'free-form' Fortran code.
  Legal FORTRAN 77 code is also legal fixed-form Fortran 9x; however this change legitimizes the use of later features, in particular to replace features marked 'obsolescent' in Fortran 90 and 'deleted' in Fortran 2018 which `gfortran` 8.x and later warn about.
- Packages containing files in the '`src`' directory with extensions '`.f90`' or '`.f95`' are now linked using the C or C++ compiler rather than the Fortran 9x compiler. This is consistent with fixed-form Fortran code and allows mixing of C++ and free-form Fortran on most platforms.
  Consequentially, a package which includes free-form Fortran 9x code which uses OpenMP should include '`SHLIB_OPENMP_CFLAGS`' (or the '`CXXFLAGS`' version if they also include C++ code) in '`PKG_LIBS`' rather than '`SHLIB_OPENMP_FCFLAGS`' — fortunately on almost all current platforms they are the same flag.
- Macro '`PKG_FFLAGS`' will be used for the compilation of both fixed-form and free-form Fortran code unless '`PKG_FCFLAGS`' is also set (in '`src/Makevars`' or '`src/Makevars.win`').
- The make macro '`F_VISIBILITY`' is now preferred for both fixed-form and free-form Fortran, for use in '`src/Makevars`' and similar.
- `R CMD INSTALL` gains a new option '`--strip`' which (where supported) strips installed shared object(s): this can also be achieved by setting the environment variable `_R_SHLIB_STRIP_` to a true value.
  The new option '`--strip-lib`' attempts stripping of static and shared libraries installed under '`lib`'.
  These are most useful on platforms using GNU `binutils` (such as Linux) and compiling with '`-g`' flags.
- There is more support for installing UTF-8-encoded packages in a strict Latin-1 locale (and probably for other Latin locales): non-ASCII comments in `R` code (and '`NAMESPACE`' files) are worked around better.

UTILITIES:

- `R CMD check` now optionally checks makefiles for correct and portable use of the '`SHLIB_OPENMP_*FLAGS`' macros.
- `R CMD check` now evaluates `\Sexpr{}` expressions (including those in macros) before checking the contents of '`Rd`' files and so detects issues both in evaluating the expressions and in the expanded contents.
- `R CMD check` now lists missing packages separated by commas and with regular quotes such as to be useful as argument in calling `install.packages(c(..))`; from a suggestion by Marcel Ramos.
- `tools::Rd2latex()` now uses UTF-8 as its default output encoding.
- `R CMD check` now checks line endings of files with extension '`.hpp`' and those under '`inst/include`'. The check now includes that a non-empty file is terminated with a newline.
  `R CMD build` will correct line endings in such files.

- `R CMD check` now tries re-building all vignettes rather than stopping at the first error: whilst doing so it adds 'bookmarks' to the log. By default (see the 'R Internals' manual) it re-builds each vignette in a separate process.
  It now checks for duplicated vignette titles (also known as 'index entries'): they are used as hyperlinks on CRAN package pages and so do need to be unique.
- `R CMD check` has more comprehensive checks on the '`data`' directory and the functioning of `data()` in a package.
- `R CMD check` now checks `autoconf`-generated '`configure`' files have their corresponding source files, including optionally attempting to regenerate them on platforms with `autoreconf`.
- `R CMD build` has a new option '`--compression`' to select the compression used for the tarball.
- `R CMD build` now removes '`src/*.mod`' files on all platforms.

C-LEVEL FACILITIES:

- New pointer protection C functions `R_PreserveInMSet` and `R_ReleaseFromMSet` have been introduced to replace `UNPROTECT_PTR`, which is not safe to mix with `UNPROTECT` (and with `PROTECT_WITH_INDEX`). Intended for use in parsers only.
- `NAMEDMAX` has been raised to 7 to allow further protection of intermediate results from (usually ill-advised) assignments in arguments to `BUILTIN` functions. Properly written package code should not be affected.
- `R_unif_index` is now considered to be part of the C API.
- `R_GetCurrentEnv()` allows C code to retrieve the current environment.

DEPRECATED AND DEFUNCT:

- Argument `compressed` of `untar()` is deprecated — it is only used for external `tar` commands which increasingly for extraction auto-detect compression and ignore their '`zjJ`' flags.
- `var(f)` and hence `sd(f)` now give an error for `factor` arguments; they gave a deprecation warning since R 3.2.3, PR#16564.
- Package **tools**' `vignetteDepends()` has been deprecated (it called a function deprecated since Feb 2016), being partly replaced by newly exported `vignetteInfo()`.
- The `f77_f2c` script has been removed: it no longer sufficed to compile the '`.f`' files in R.
- The deprecated legacy support of `make` macros such as '`CXX1X`' has been removed: use the '`CXX11`' forms instead.
- Make macro '`F77_VISIBILITY`' is deprecated in favour of '`F_VISIBILITY`'.
- Make macros '`F77`', '`FCPIFCPLAGS`' and '`SHLIB_OPENMP_FCFLAGS`' are deprecated in favour of '`FC`', '`FPICFLAGS`' and '`SHLIB_OPENMP_FFLAGS`' respectively.
- `$.data.frame` had become an expensive version of the default method, so has been removed. (Thanks to Radford Neal for picking this up and to Duncan Murdoch for providing a patch.)

BUG FIXES:

- `replayPlot(r)` now also works in the same R session when `r` has been "reproduced" from serialization, typically after saving to and reading from an RDS file.
- `substr()` and `substring()` now signal an error when the input is invalid UTF-8.
- `file.copy()` now works also when its argument `to` is of length greater than one.
- `mantelhaen.test()` no longer suffers from integer overflow in largish cases, thanks to Ben Bolker's PR#17383.

- Calling `setGeneric("foo")` in a package no longer fails when the enclosing environment of the implicit generic `foo()` is `.GlobalEnv`.
- `untar(file("<some>.tar.gz"),*)` now gives a better error message, suggesting to use `gzfile()` instead.
- Method dispatch uses more relevant environments when looking up class definitions.
- The documentation for `identify()` incorrectly claimed that the indices of identified points were returned in the order that the points were selected. `identify()` now has a new argument `order` to allow the return value to include the order in which points were identified; the documentation has been updated. Reported by Richard Rowe and Samuel Granjeaud.
- `order(....,decreasing=c(TRUE,FALSE))` could fail in some cases. Reported from StackOverflow via Karl Nordström.
- User macros in Rd files now accept empty and multi-line arguments.
- Changes in `print.*()`, thanks to Lionel Henry's patches in PR#17398:
  - Printing lists, pairlists or attributes containing calls with S3 class no longer evaluate those.
  - Printing S4 objects within lists and pairlists dispatches with `show()` rather than `print()`, as with auto-printing.
  - The indexing tags (names or `[[<n>]]`) of recursive data structures are now printed correctly in complex cases.
  - Arguments supplied to `print()` are now properly forwarded to methods when printing lists, pairlists or attributes containing S3 objects.
  - The print parameters are now preserved when printing S3 objects or deparsing symbols and calls. Previously, printing lists containing S3 objects or expressions would reset these parameters.
  - Printing lists, pairlists or attributes containing functions now uses `srcref` attributes if present.
- Calling `install.packages()` with a length zero `pkgs` argument now is a no-op (PR#17422).
- `unlist(x)` now returns a correct `factor` when `x` is a nested list with factor leaves, fixing PR#12572 and PR#17419.
- The documentation `help(family)` gives more details about the `aic` component, thanks to Ben Bolker's prompting.
- The documentation for `attributes` and `` `attributes<-` `` now gives `x` as name of the first and main argument which the implementation has been requiring, fixing PR#17434. For consistency, the first argument name is also changed from `obj` to `x` for `` `mostattributes<-` ``.
- `strwidth()` now uses `par("font")` as default font face (PR#17352).
- `plot(<table>,log="x")` no longer warns about `log`.
- The `print()` method for `"htest"` objects now formats the test statistic and parameter directly and hence no longer rounds to units *before* the decimal point. Consequently, printing of `t.test()` results with a small number of digits now shows non-large `df`'s to the full precision (PR#17444).
- `kruskal.test()` and `fligner.test()` no longer erroneously insist on numeric `g` group arguments (PR#16719).
- Printing a news db via the browser now does a much better job (PR#17433).
- `print.aov()` missed column names in the multivariate case due to misspelling (reported by Chris Andrews).
- `axis()` now creates valid `at` locations also for small subnormal number ranges in log scale plots.

- `format.POSIXlt()` now also recycles the `zone` and `gmtoff` list components to full length when needed, and its internal C code detects `have_zone` in more cases. In some cases, this changes its output to become compatible with `format.POSIXct()`.
- On Windows, `detectCores()` in package **parallel** now detects processors in all processor groups, not just the group R is running in (impacts particularly systems with more than 64 logical processors). Reported by Arunkumar Srinivasan.
- On Windows, `socketSelect()` would hang with more than 64 sockets, and hence `parallel::clusterApplyLB()` would hang with more than 64 workers. Reported by Arunkumar Srinivasan.
- `as(1L,"double")` now does coerce (PR#17457).
- `lm.influence()`, `influence.measures()`, `rstudent()` etc now work (more) correctly for multivariate models (`"mlm"`), thanks to (anonymous) stackoverflow remarks.
- `sample.int(2.9,*,replace=TRUE)` again behaves as documented and as in R ¡ 3.0.0, namely identically to `sample.int(2,..)`.
- Fixes to `convertColor()` for chromatic adaptation; thanks to Brodie Gaslam PR#17473.
- Using \`Sexpr[stage=install]{..}` to create an '`Rd`' section no longer gives a warning in `R CMD check`; problem originally posted by Gábor Csárdi, then reported as PR#17479 with a partial patch by Duncan Murdoch.
- Parse data now include a special node for equal assignment.
- `split.default()` no longer relies on `[[<-()`, so it behaves as expected when splitting an object by a factor with the empty string as one of its levels. Thanks to Brad Friedman for the report.
- Line numbers in messages about '`.Rd`' files are now more reliable, thanks to a patch from Duncan Murdoch.
- In the `numeric` method for `all.equal()`, a numeric `scale` argument is now checked to be positive and allowed to be of length ¿ 1. (The latter worked originally and with a warning in recent years).
- Deferred string conversions now record the `OutDec` option setting when not equal to the default. Reported by Michael Sannella.
- When `y` is numeric and `f` a `factor`, `plot(y ~ f)` nicely uses "y" and "f" as y- and x-labels. The more direct `boxplot(y ~ f)` now does too. The new argument `ann = FALSE` may be used to suppress these.
- Subassignment to no/empty rows of a data frame is more consistent and typically a no-op in all cases instead of sometimes an error; part of Emil Bode's PR#17483.
- Calls like `formatC(*,zero.print = "< 0.001")` no longer give an error and are further improved via new optional argument `replace.zero`. Reported by David Hugh-Jones.
- `methods::formalArgs("<fn>")` now finds the same function as `formals("<fn>")`, fixing Emil Bode's PR#17499.
- The **methods** package better handles duplicated class names across packages.
- The default method of `seq()` now avoids integer overflow, thanks to the report and "cumsum" patch of Suharto Anggono's PR#17497.
- `sub()` no longer loses encodings for non-ASCII replacements (PR#17509).
- Fix for rotated raster image on X11 device. (Partial fix for PR#17148; thanks to Mikko Korpela).
- `formula(model.frame(frml,..))` now returns `frml` in all cases, thanks to Bill Dunlap. The previous behavior is available as `DF2formula(<model.frame>)`.
- `ar.ols()` also returns scalar `var.pred` in univariate case (PR#17517).

- `normalizePath()` now treats `NA` path as non-existent and normalizes it to `NA`. `file.access()` treats `NA` file name as non-existent. `file.edit()` and connection functions such as `file()` now treat `NA` file names as errors.
- The internal `regularize.values()` auxiliary of `approx()`, `splinefun()` etc now warns again when there are ties and the caller did not specify `ties`. Further, it no longer duplicates `x` and `y` unnecessarily when `x` is already sorted (PR#17515).
- `strtoi("",base)` now gives `NA` on all platforms, following its documentation. Reported by Michael Chirico.
- In the definition of an S4 class, prototype elements are checked against the slots of the class, with giving a prototype for an undefined slot now being an error. (Reported by Bill Dunlap.)
- From `setClassUnion()`, if environment variable `_R_METHODS_SHOW_CHECKSUBCLASSES` is set to true, the internal `.checkSubclasses()` utility prints debugging info to see where it is used.
- `max.col(m)` with an `m` of zero columns now returns integer `NA` (instead of `1`).
- `axTicks()` no longer returns small "almost zero" numbers (in exponential format) instead of zero, fixing Ilario Gelmetti's PR#17534.
- `isSymmetric(matrix(0,dimnames=list("A","b")))` is `FALSE` again, as always documented.
- The `cairo_pdf` graphics device (and other Cairo-based devices) now clip correctly to the right and bottom border.
  There was an off-by-one-pixel bug, reported by Lee Kelvin.
- `as.roman(3) <= 2:4` and all other comparisons now work, as do group `"Summary"` function calls such as `max(as.roman(sample(20)))` and `as.roman(NA)`. (Partly reported by Bill Dunlap in PR#17542.)
- `reformulate("x",response = "sin(y)")` no longer produces extra back quotes, PR#17359, and gains new optional argument `env`.
- When reading console input from '`stdin`' with re-encoding (`R --encoding=enc < input`) the code on a Unix-alike now ensures that each converted input line is terminated with a newline even if re-encoding fails.
- `as.matrix.data.frame()` now produces better strings from logicals, thanks to PR#17548 from Gabe Becker.
- The S4 generic signature of `rowSums()`, `rowMeans()`, `colSums()` and `colMeans()` is restricted to `"x"`.
- `match(x,tab)` now works for long *character* vectors `x`, thanks to PR#17552 by Andreas Kersting.
- Class unions are unloaded when their namespace is unloaded (PR#17531, adapted from a patch by Brodie Gaslam).
- `selectMethod()` is robust to ANY-truncation of method signatures (thanks to Herve Pages for the report).



CHANGES IN R 3.5.3

INSTALLATION on a UNIX-ALIKE:

- Detection of flags for C++98/11/14/17 has been improved: in particular if CXX??STD is set, it is tried first with no additional flags.

PACKAGE INSTALLATION:

- New macro '`F_VISIBILITY`' as an alternative to '`F77_VISIBILITY`'. This will become the preferred form in R 3.6.0.

BUG FIXES:

- `writeLines(readLines(fnam),fnam)` now works as expected, thanks to Peter Meissner's PR#17528.
- `setClassUnion()` no longer warns, but uses `message()` for now, when encountering "non local" subclasses of class members.
- `stopifnot(exprs = T)` no longer fails.



CHANGES IN R 3.5.2

PACKAGE INSTALLATION:

- New macro '`CXX_VISIBILITY`' analogous to '`C_VISIBILITY`' (which several packages have been misusing for C++ code) for the default C++ compiler (but not necessarily one used for non-default C++ dialects like C++14).

TESTING:

- The random number generator tests in '`tests/p-r-random-tests.R`' no longer fail occasionally as they now randomly sample from "certified" random seeds.

BUG FIXES:

- The `"glm"` method of `drop1()` miscalculated the score test (`test="Rao"`) when the model contained an offset.
- Linear multiple empty models such as `lm(y ~ 0)` now have a correctly dimensioned empty coefficient matrix; reported by Brett Presnell.
- `vcov(<empty mlm>)` and hence `confint()` now work (via a consistency change in `summary.lm()`).
- `confint(<multiple lm()>)` now works correctly; reported on R-devel by Steven Pav.
- `quade.test()` now also works correctly when its arguments are not yet sorted along `groups`, fixing PR#15842.
- Installation on a Unix-alike tries harder to link to the '`pthread`' library where required (rather than relying on OpenMP to provide it: configuring with '`--disable-openmp`' was failing on some Linux systems).
- The `data.frame` method for `print(x)` is fast now also for large data frames `x` and got an optional argument `max`, thanks to suggestions by Juan Telleria.
- `hist()` no longer integer overflows in very rare cases, fixing PR#17450.
- `untar()` ignored a character `compressed` argument: however many external `tar` programs ignore the flags which should have been set and automagically choose the compression type, and if appropriate `gzip` or `bzip2` compression would have been chosen from the magic header of the tarball.
- `zapsmall(x)` now works for more "number-like" objects.
- The tools-internal function called from `R CMD INSTALL` now gets a `warnOption = 1` argument and only sets `options(warn = warnOption)` when that increases the warning level (PR#17453).
- Analogously, the tools-internal function called from `R CMD check` gets a `warnOption = 1` argument and uses the larger of that and `getOption("warn")`, also allowing to be run with increased warning level.

- Parse data now have deterministic parent nodes (PR#16041).
- Calling `match()` with length one `x` and POSIXlt `table` gave a segfault (PR#17459).
- Fork clusters could hang due to a race condition in cluster initialization (`makeCluster()`).
- `nextn(n)` now also works for larger `n` and no longer loops infinitely for e.g, `n <-214e7`.
- `cooks.distance()` and `rstandard()` now work correctly for multiple linear models (`"mlm"`).
- `polym()` and corresponding `lm()` prediction now also work for a boundary "vector" case fixing PR#17474, reported by Alexandre Courtiol.
- With a very large number of variables `terms()` could segfault (PR#17480).
- `cut(rep(0,7))` now works, thanks to Joey Reid and Benjamin Tyner (PR#16802).
- `download.file(*,method = "curl",cacheOK = FALSE)` should work now on Windows, thanks to Kevin Ushey's patch in PR#17323.
- `duplicated(<dataframe with 'f'>)` now works, too, thanks to Andreas Kersting's PR#17485; ditto for `anyDuplicated()`.
- `legend(*,cex = 1:2)` now works less badly.
- The `print()` method for `POSIXct` and `POSIXlt` now correctly obeys `getOption("max.print")`, fixing a long-standing typo, and it also gets a corresponding optional `max` argument.
- Unserialization of raw vectors serialized in ASCII representation now works correctly.
- `<data frame>[TRUE,<new>] <-list(c1,c2)` now works correctly, thanks to Suharto Anggono's PR#15362 and Emil Bode's patch in PR#17504.
- `seq.int(*,by=by,length=n)` no longer wrongly "drops fractional parts" when `by` is integer, thanks to Suharto Anggono's report PR#17506.
- Buffering is disabled for `file()` connections to non-regular files (like sockets), as well as `fifo()` and `pipe()` connections. Fixes PR#17470, reported by Chris Culnane.



CHANGES IN R 3.5.1

BUG FIXES:

- `file("stdin")` is no longer considered seekable.
- `dput()` and `dump()` are no longer truncating when `options(deparse.max.lines = *)` is set.
- Calls with an S3 class are no longer evaluated when printed, fixing part of PR#17398, thanks to a patch from Lionel Henry.
- Allow `file` argument of `Rscript` to include space even when it is first on the command line.
- `callNextMethod()` uses the generic from the environment of the calling method. Reported by Hervé Pagès with well documented examples.
- Compressed file connections are marked as blocking.
- `optim(*,lower = c(-Inf,-Inf))` no longer warns (and switches the method), thanks to a suggestion by John Nash.
- `predict(fm,newdata)` is now correct also for models where the formula has terms such as `splines::ns(..)` or `stats::poly(..)`, fixing PR#17414, based on a patch from Duncan Murdoch.
- `simulate.lm(glm(*,gaussian(link = <non-default>)))` has been corrected, fixing PR#17415 thanks to Alex Courtiol.

- `unlist(x)` no longer fails in some cases of nested empty lists. Reported by Steven Nydick.
- `qr.coef(qr(<all 0,w/ colnames>))` now works. Reported by Kun Ren.
- The radix sort is robust to vectors with ¿1 billion elements (but long vectors are still unsupported). Thanks to Matt Dowle for the fix.
- Terminal connections (e.g., stdin) are no longer buffered. Fixes PR#17432.
- `deparse(x)`, `dput(x)` and `dump()` now respect `c()`'s argument names `recursive` and `use.names`, e.g., for `x <-setNames(0,"recursive")`, thanks to Suharto Anggono's PR#17427.
- Unbuffered connections now work with encoding conversion. Reported by Stephen Berman.
- '`.Renviron`' on Windows with `Rgui` is again by default searched for in user documents directory when invoked *via* the launcher icon. Reported by Jeroen Ooms.
- `printCoefmat()` now also works with explicit `right=TRUE`.
- `print.noquote()` now also works with explicit `quote=FALSE`.
- The default method for `pairs(..,horInd=*,verInd=*)` now gets the correct order, thanks to reports by Chris Andrews and Gerrit Eichner. Additionally, when `horInd` or `verInd` contain only a subset of variables, all the axes are labeled correctly now.
- `agrep("..|..",..,fixed=FALSE)` now matches when it should, thanks to a reminder by Andreas Kolter.
- `str(ch)` now works for more invalid multibyte strings.



CHANGES IN R 3.5.0

SIGNIFICANT USER-VISIBLE CHANGES:

- All packages are by default byte-compiled on installation. This makes the installed packages larger (usually marginally so) and may affect the format of messages and tracebacks (which often exclude `.Call` and similar).

NEW FEATURES:

- `factor()` now uses `order()` to sort its levels, rather than `sort.list()`. This allows `factor()` to support custom vector-like objects if methods for the appropriate generics are defined. It has the side effect of making `factor()` succeed on empty or length-one non-atomic vector(-like) types (e.g., `"list"`), where it failed before.
- `diag()` gets an optional `names` argument: this may require updates to packages defining S4 methods for it.
- `chooseCRANmirror()` and `chooseBioCmirror()` no longer have a `useHTTPS` argument, not needed now all R builds support '`https://`' downloads.
- New `summary()` method for `warnings()` with a (somewhat experimental) `print()` method.
- (**methods** package.) `.self` is now automatically registered as a global variable when registering a reference class method.
- `tempdir(check = TRUE)` recreates the `tempdir()` directory if it is no longer valid (e.g. because some other process has cleaned up the '`/tmp`' directory).
- New `askYesNo()` function and `"askYesNo"` option to ask the user binary response questions in a customizable but consistent way. (Suggestion of PR#17242.)
- New low level utilities `...elt(n)` and `...length()` for working with `...` parts inside a function.

- `isTRUE()` is more tolerant and now true in

  ```
  x <- rlnorm(99)
  isTRUE(median(x) == quantile(x)["50%"])
  ```

  New function `isFALSE()` defined analogously to `isTRUE()`.
- The default symbol table size has been increased from 4119 to 49157; this may improve the performance of symbol resolution when many packages are loaded. (Suggested by Jim Hester.)
- `line()` gets a new option `iter = 1`.
- Reading from connections in text mode is buffered, significantly improving the performance of `readLines()`, as well as `scan()` and `read.table()`, at least when specifying `colClasses`.
- `order()` is smarter about picking a default sort `method` when its arguments are objects.
- `available.packages()` has two new arguments which control if the values from the per-session repository cache are used (default true, as before) and if so how old cached values can be used (default one hour).
  These arguments can be passed from `install.packages()`, `update.packages()` and functions calling that: to enable this `available.packages()`, `packageStatus()` and `download.file()` gain a `...` argument.
- `packageStatus()`'s `upgrade()` method no longer ignores its `...` argument but passes it to `install.packages()`.
- `installed.packages()` gains a `...` argument to allow arguments (including `noCache`) to be passed from `new.packages()`, `old.packages()`, `update.packages()` and `packageStatus()`.
- `factor(x,levels,labels)` now allows duplicated `labels` (not duplicated `levels`!). Hence you can map different values of `x` to the same level directly.
- Attempting to use `names<-()` on an S4 derivative of a basic type no longer emits a warning.
- The `list` method of `within()` gains an option `keepAttrs = FALSE` for some speed-up.
- `system()` and `system2()` now allow the specification of a maximum elapsed time ('timeout').
- `debug()` supports debugging of methods on any object of S4 class `"genericFunction"`, including group generics.
- Attempting to increase the length of a variable containing `NULL` using `length()<-` still has no effect on the target variable, but now triggers a warning.
- `type.convert()` becomes a generic function, with additional methods that operate recursively over list and `data.frame` objects. Courtesy of Arni Magnusson (PR#17269).
- `lower.tri(x)` and `upper.tri(x)` only needing `dim(x)` now work via new functions `.row()` and `.col()`, so no longer call `as.matrix()` by default in order to work efficiently for all kind of matrix-like objects.
- `print()` methods for `"xgettext"` and `"xngettext"` now use `encodeString()` which keeps, e.g. `"\n"`, visible. (Wish of PR#17298.)
- `package.skeleton()` gains an optional `encoding` argument.
- `approx()`, `spline()`, `splinefun()` and `approxfun()` also work for long vectors.
- `deparse()` and `dump()` are more useful for S4 objects, `dput()` now using the same internal C code instead of its previous imperfect workaround R code. S4 objects now typically deparse perfectly, i.e., can be recreated identically from deparsed code.

`dput()`, `deparse()` and `dump()` now print the `names()` information only once, using the more readable `(tag = value)` syntax, notably for `list()`s, i.e., including data frames.
These functions gain a new control option `"niceNames"` (see `.deparseOpts()`), which when set (as by default) also uses the `(tag = value)` syntax for atomic vectors. On the other hand, without deparse options `"showAttributes"` and `"niceNames"`, names are no longer shown also for lists. `as.character(list( c (one = 1)))` now includes the name, as `as.character(list(list(one = 1)))` has always done.
`m:n` now also deparses nicely when $m > n$.
The `"quoteExpressions"` option, also part of `"all"`, no longer `quote()`s formulas as that may not re-parse identically. (PR#17378)

- If the option `setWidthOnResize` is set and `TRUE`, R run in a terminal using a recent `readline` library will set the `width` option when the terminal is resized. Suggested by Ralf Goertz.
- If multiple `on.exit()` expressions are set using `add = TRUE` then all expressions will now be run even if one signals an error.
- `mclapply()` gets an option `affinity.list` which allows more efficient execution with heterogeneous processors, thanks to Helena Kotthaus.
- The `character` methods for `as.Date()` and `as.POSIXlt()` are more flexible *via* new arguments `tryFormats` and `optional`: see their help pages.
- `on.exit()` gains an optional argument `after` with default `TRUE`. Using `after = FALSE` with `add = TRUE` adds an exit expression before any existing ones. This way the expressions are run in a first-in last-out fashion. (From Lionel Henry.)
- On Windows, `file.rename()` internally retries the operation in case of error to attempt to recover from possible anti-virus interference.
- Command line completion on '`::`' now also includes lazy-loaded data.
- If the `TZ` environment variable is set when date-time functions are first used, it is recorded as the session default and so will be used rather than the default deduced from the OS if `TZ` is subsequently unset.
- There is now a `[` method for class `"DLLInfoList"`.
- `glm()` and `glm.fit` get the same `singular.ok = TRUE` argument that `lm()` has had forever. As a consequence, in `glm(*,method = <your_own>)`, user specified methods need to accept a `singular.ok` argument as well.
- `aspell()` gains a filter for Markdown ('`.md`' and '`.Rmd`') files.
- `intToUtf8(multiple = FALSE)` gains an argument to allow surrogate pairs to be interpreted.
- The maximum number of DLLs that can be loaded into R e.g. *via* `dyn.load()` has been increased up to 614 when the OS limit on the number of open files allows.
- `Sys.timezone()` on a Unix-alike caches the value at first use in a session: *inter alia* this means that setting `TZ` later in the session affects only the *current* time zone and not the *system* one.
  `Sys.timezone()` is now used to find the system timezone to pass to the code used when R is configured with '`--with-internal-tzcode`'.
- When `tar()` is used with an external command which is detected to be GNU `tar` or libarchive `tar` (aka `bsdtar`), a different command-line is generated to circumvent line-length limits in the shell.
- `system(*,intern = FALSE)`, `system2()` (when not capturing output), `file.edit()` and `file.show()` now issue a warning when the external command cannot be executed.

- The "default" (`"lm"` etc) methods of `vcov()` have gained new optional argument `complete = TRUE` which makes the `vcov()` methods more consistent with the `coef()` methods in the case of singular designs. The former (back-compatible) behavior is given by `vcov(*,complete = FALSE)`.
- `coef()` methods (for `lm` etc) also gain a `complete = TRUE` optional argument for consistency with `vcov()`.
  For `"aov"`, both `coef()` and `vcov()` methods remain back-compatibly consistent, using the *other* default, `complete = FALSE`.
- `attach(*,pos = 1)` is now an error instead of a warning.
- New function `getDefaultCluster()` in package **parallel** to get the default cluster set via `setDefaultCluster()`.
- `str(x)` for atomic objects `x` now treats both cases of `is.vector(x)` similarly, and hence much less often prints `"atomic"`. This is a slight non-back-compatible change producing typically both more informative and shorter output.
- `gc()` gets new argument `full`.
- `write.dcf()` gets optional argument `useBytes`.
- New, partly experimental `packageDate()` which tries to get a valid `"Date"` object from a package '`DESCRIPTION`' file, thanks to suggestions in PR#17324.
- `tools::resaveRdaFiles()` gains a `version` argument, for use when packages should remain compatible with earlier versions of R.
- `ar.yw(x)` and hence by default `ar(x)` now work when `x` has `NA`s, mostly thanks to a patch by Pavel Krivitsky in PR#17366. The `ar.yw.default()`'s AIC computations have become more efficient by using `determinant()`.
- New `warnErrList()` utility (from package **nlme**, improved).
- By default the (arbitrary) signs of the loadings from `princomp()` are chosen so the first element is non-negative.
- If '`--default-packages`' is not used, then `Rscript` now checks the environment variable `R_SCRIPT_DEFAULT_PACKAGES`. If this is set, then it takes precedence over `R_DEFAULT_PACKAGES`. If default packages are not specified on the command line or by one of these environment variables, then `Rscript` now uses the same default packages as `R`. For now, the previous behavior of not including **methods** can be restored by setting the environment variable `R_SCRIPT_LEGACY` to '`yes`'.
- When a package is found more than once, the warning from `find.package(*,verbose=TRUE)` lists all library locations.
- POSIXt objects can now also be rounded or truncated to month or year.
- `stopifnot()` can be used alternatively via new argument `exprs` which is nicer and useful when testing several expressions in one call.
- The environment variable `R_MAX_VSIZE` can now be used to specify the maximal vector heap size. On macOS, unless specified by this environment variable, the maximal vector heap size is set to the maximum of 16GB and the available physical memory. This is to avoid having the `R` process killed when macOS over-commits memory.
- `sum(x)` and `sum(x1,x2,..,x<N>)` with many or long logical or integer vectors no longer overflows (and returns `NA` with a warning), but returns `double` numbers in such cases.
- Single components of `"POSIXlt"` objects can now be extracted and replaced via `[` indexing with 2 indices.
- S3 method lookup now searches the namespace registry after the top level environment of the calling environment.
- Arithmetic sequences created by `1:n`, `seq_along`, and the like now use compact internal representations via the `ALTREP` framework. Coercing integer and numeric vectors

to character also now uses the `ALTREP` framework to defer the actual conversion until first use.

- Finalizers are now run with interrupts suspended.
- `merge()` gains new option `no.dups` and by default suffixes the second of two duplicated column names, thanks to a proposal by Scott Ritchie (and Gabe Becker).
- `scale.default(x,center,scale)` now also allows `center` or `scale` to be "numeric-alike", i.e., such that `as.numeric(.)` coerces them correctly. This also eliminates a wrong error message in such cases.
- `par*apply` and `par*applyLB` gain an optional argument `chunk.size` which allows to specify the granularity of scheduling.
- Some `as.data.frame()` methods, notably the `matrix` one, are now more careful in not accepting duplicated or `NA` row names, and by default produce unique non-NA row names. This is based on new function `.rowNamesDF(x,make.names = *) <-rNms` where the logical argument `make.names` allows to specify *how* invalid row names `rNms` are handled. `.rowNamesDF()` is a "workaround" compatible default.
- R has new serialization format (version 3) which supports custom serialization of `ALTREP` framework objects. These objects can still be serialized in format 2, but less efficiently. Serialization format 3 also records the current native encoding of unflagged strings and converts them when de-serialized in R running under different native encoding. Format 3 comes with new serialization magic numbers (RDA3, RDB3, RDX3). Format 3 can be selected by `version = 3` in `save()`, `serialize()` and `saveRDS()`, but format 2 remains the default for all serialization and saving of the workspace. Serialized data in format 3 cannot be read by versions of R prior to version 3.5.0.
- The `"Date"` and "date-time" classes `"POSIXlt"` and `"POSIXct"` now have a working `length<-()` method, as wished in PR#17387.
- `optim(*,control = list(warn.1d.NelderMead = FALSE))` allows to turn off the warning when applying the default `"Nelder-Mead"` method to 1-dimensional problems.
- `matplot(..,panel.first = .)` etc now work, as `log` becomes explicit argument and `...` is passed to `plot()` unevaluated, as suggested by Sebastian Meyer in PR#17386.
- Interrupts can be suspended while evaluating an expression using `suspendInterrupts`. Subexpression can be evaluated with interrupts enabled using `allowInterrupts`. These functions can be used to make sure cleanup handlers cannot be interrupted.
- R 3.5.0 includes a framework that allows packages to provide alternate representations of basic R objects (`ALTREP`). The framework is still experimental and may undergo changes in future R releases as more experience is gained. For now, documentation is provided in `https://svn.r-project.org/R/branches/ALTREP/ALTREP.html`.

UTILITIES:

- `install.packages()` for source packages now has the possibility to set a 'timeout' (elapsed-time limit). For serial installs this uses the `timeout` argument of `system2()`: for parallel installs it requires the `timeout` utility command from GNU **coreutils**.
- It is now possible to set 'timeouts' (elapsed-time limits) for most parts of `R CMD check` *via* environment variables documented in the 'R Internals' manual.
- The 'BioC extra' repository which was dropped from Bioconductor 3.6 and later has been removed from `setRepositories()`. This changes the mapping for 6–8 used by `setRepositories(ind=)`.

- `R CMD check` now also applies the settings of environment variables `_R_CHECK_SUGGESTS_ONLY_` and `_R_CHECK_DEPENDS_ONLY_` to the re-building of vignettes.
- `R CMD check` with environment variable `_R_CHECK_DEPENDS_ONLY_` set to a true value makes test-suite-management packages available and (for the time being) works around a common omission of **rmarkdown** from the '`VignetteBuilder`' field.

INSTALLATION on a UNIX-ALIKE:

- Support for a system Java on macOS has been removed — install a fairly recent Oracle Java (see 'R Installation and Administration' §C.3.2).
- `configure` works harder to set additional flags in '`SAFE_FFLAGS`' only where necessary, and to use flags which have little or no effect on performance.
  In rare circumstances it may be necessary to override the setting of '`SAFE_FFLAGS`'.
- C99 functions `expm1`, `hypot`, `log1p` and `nearbyint` are now required.
- `configure` sets a '`-std`' flag for the C++ compiler for all supported C++ standards (e.g., '`-std=gnu++11`' for the C++11 compiler). Previously this was not done in a few cases where the default standard passed the tests made (e.g. `clang 6.0.0` for C++11).

C-LEVEL FACILITIES:

- 'Writing R Extensions' documents macros `MAYBE_REFERENCED`, `MAYBE_SHARED` and `MARK_NOT_MUTABLE` that should be used by package `C` code instead `NAMED` or `SET_NAMED`.
- The object header layout has been changed to support merging the `ALTREP` branch. This requires re-installing packages that use compiled code.
- 'Writing R Extensions' now documents the `R_tryCatch`, `R_tryCatchError`, and `R_UnwindProtect` functions.
- `NAMEDMAX` has been raised to 3 to allow protection of intermediate results from (usually ill-advised) assignments in arguments to `BUILTIN` functions. Package `C` code using `SET_NAMED` may need to be revised.

DEPRECATED AND DEFUNCT:

- `Sys.timezone(location = FALSE)` is defunct, and is ignored (with a warning).
- `methods:::bind_activation()` is defunct now; it typically has been unneeded for years.
  The undocumented 'hidden' objects `.__H__.cbind` and `.__H__.rbind` in package **base** are deprecated (in favour of `cbind` and `rbind`).
- The declaration of `pythag()` in '`Rmath.h`' has been removed — the entry point has not been provided since R 2.14.0.

BUG FIXES:

- `printCoefmat()` now also works without column names.
- The S4 methods on `Ops()` for the `"structure"` class no longer cause infinite recursion when the structure is not an S4 object.
- `nlm(f,..)` for the case where `f()` has a `"hessian"` attribute now computes $LL' = H + \mu I$ correctly. (PR#17249).
- An S4 method that "rematches" to its generic and overrides the default value of a generic formal argument to `NULL` no longer drops the argument from its formals.
- `Rscript` can now accept more than one argument given on the '`#!`' line of a script. Previously, one could only pass a single argument on the '`#!`' line in Linux.
- Connections are now written correctly with encoding `"UTF-16LE"`. (PR#16737).

- Evaluation of `..0` now signals an error. When `..1` is used and `...` is empty, the error message is more appropriate.
- (Windows mainly.) Unicode code points which require surrogate pairs in UTF-16 are now handled. All systems should properly handle surrogate pairs, even those systems that do not need to make use of them. (PR#16098)
- `stopifnot(e,e2,...)` now evaluates the expressions sequentially and in case of an error or warning shows the relevant expression instead of the full `stopifnot(..)` call.
- `path.expand()` on Windows now accepts paths specified as UTF-8-encoded character strings even if not representable in the current locale. (PR#17120)
- `line(x,y)` now correctly computes the medians of the left and right group's x-values and in all cases reproduces straight lines.
- Extending S4 classes with slots corresponding to special attributes like `dim` and `dimnames` now works.
- Fix for `legend()` when `fill` has multiple values the first of which is `NA` (all colours used to default to `par(fg)`). (PR#17288)
- `installed.packages()` did not remove the cached value for a library tree that had been emptied (but would not use the old value, just waste time checking it).
- The documentation for `installed.packages(noCache = TRUE)` incorrectly claimed it would refresh the cache.
- `aggregate(<data.frame>)` no longer uses spurious names in some cases. (PR#17283)
- `object.size()` now also works for long vectors.
- `packageDescription()` tries harder to solve re-encoding issues, notably seen in some Windows locales. This fixes the `citation()` issue in PR#17291.
- `poly(<matrix>,3)` now works, thanks to prompting by Marc Schwartz.
- `readLines()` no longer segfaults on very large files with embedded `'\0'` (aka 'nul') characters. (PR#17311)
- `ns()` (package **splines**) now also works for a single observation. `interpSpline()` gives a more friendly error message when the number of points is less than four.
- `dist(x,method = "canberra")` now uses the correct definition; the result may only differ when `x` contains values of differing signs, e.g. not for 0-1 data.
- `methods:::cbind()` and `methods:::rbind()` avoid deep recursion, thanks to Suharto Anggono via PR#17300.
- Arithmetic with zero-column data frames now works more consistently; issue raised by Bill Dunlap.
  Arithmetic with data frames gives a data frame for `^` (which previously gave a numeric matrix).
- `pretty(x,n)` for large `n` or large `diff(range(x))` now works better (though it was never meant for large `n`); internally it uses the same rounding fuzz (1e-10) as `seq.default()` — as it did up to 2010-02-03 when both were 1e-7.
- Internal C-level `R_check_class_and_super()` and hence `R_check_class_etc()` now also consider non-direct super classes and hence return a match in more cases. This e.g., fixes behaviour of derived classes in package **Matrix**.
- Reverted unintended change in behavior of `return` calls in `on.exit` expressions introduced by stack unwinding changes in R 3.3.0.
- Attributes on symbols are now detected and prevented; attempt to add an attribute to a symbol results in an error.
- `fisher.test(*,workspace = <n>)` now may also increase the internal stack size which allows larger problem to be solved, fixing PR#1662.

- The **methods** package no longer directly copies slots (attributes) into a prototype that is of an "abnormal" (reference) type, like a symbol.
- The **methods** package no longer attempts to call `length<-()` on `NULL` (during the bootstrap process).
- The **methods** package correctly shows methods when there are multiple methods with the same signature for the same generic (still not fully supported, but at least the user can see them).
- `sys.on.exit()` is now always evaluated in the right frame. (From Lionel Henry.)
- `seq.POSIXt(*,by = "<n> DSTdays")` now should work correctly in all cases and is faster. (PR#17342)
- `.C()` when returning a logical vector now always maps values other than FALSE and NA to TRUE (as documented).
- Subassignment with zero length vectors now coerces as documented (PR#17344). Further, `x <-numeric(); x[1] <-character()` now signals an error 'replacement has length zero' (or a translation of that) instead of doing nothing.
- (Package **parallel**.) `mclapply()`, `pvec()` and `mcparallel()` (when `mccollect()` is used to collect results) no longer leave zombie processes behind.
- `R CMD INSTALL <pkg>` now produces the intended error message when, e.g., the `LazyData` field is invalid.
- `as.matrix(dd)` now works when the data frame `dd` contains a column which is a data frame or matrix, including a 0-column matrix/d.f. .
- `mclapply(X,mc.cores)` now follows its documentation and calls `lapply()` in case `mc.cores = 1` also in the case `mc.preschedule` is false. (PR#17373)
- `aggregate(<data.frame>,drop=FALSE)` no longer calls the function on ¡empty¿ parts but sets corresponding results to `NA`. (Thanks to Suharto Anggono's patches in PR#17280).
- The `duplicated()` method for data frames is now based on the `list` method (instead of string coercion). Consequently `unique()` is better distinguishing data frame rows, fixing PR#17369 and PR#17381. The methods for matrices and arrays are changed accordingly.
- Calling `names()` on an S4 object derived from `"environment"` behaves (by default) like calling `names()` on an ordinary environment.
- `read.table()` with a non-default separator now supports quotes following a non-whitespace character, matching the behavior of `scan()`.
- `parLapplyLB` and `parSapplyLB` have been fixed to do load balancing (dynamic scheduling). This also means that results of computations depending on random number generators will now really be non-reproducible, as documented.
- Indexing a list using dollar and empty string (`l$""`) returns NULL.
- Using `\usage{ data(<name>,package="<pkg>") }` no longer produces `R CMD check` warnings.
- `match.arg()` more carefully chooses the environment for constructing default `choices`, fixing PR#17401 as proposed by Duncan Murdoch.
- Deparsing of consecutive `!` calls is now consistent with deparsing unary `-` and `+` calls and creates code that can be reparsed exactly; thanks to a patch by Lionel Henry in PR#17397. (As a side effect, this uses fewer parentheses in some other deparsing involving `!` calls.)



CHANGES IN R 3.4.4

NEW FEATURES:

- `Sys.timezone()` tries more heuristics on Unix-alikes and so is more likely to succeed (especially on Linux). For the slowest method, a warning is given recommending that `TZ` is set to avoid the search.
- The version of LAPACK included in the sources has been updated to 3.8.0 (for the routines used by R, a very minor bug-fix change).
- `parallel::detectCores(logical = FALSE)` is ignored on Linux systems, since the information is not available with virtualized OSes.

INSTALLATION on a UNIX-ALIKE:

- `configure` will use `pkg-config` to find the flags to link to `jpeg` if available (as it should be for the recently-released `jpeg-9c` and `libjpeg-turbo`). (This amends the code added in R 3.3.0 as the module name in `jpeg-9c` is not what that tested for.)

DEPRECATED AND DEFUNCT:

- `Sys.timezone(location = FALSE)` (which was a stop-gap measure for Windows long ago) is deprecated. It no longer returns the value of environment variable `TZ` (usually a location).
- Legacy support of `make` macros such as '`CXX1X`' is formally deprecated: use the '`CXX11`' forms instead.

BUG FIXES:

- `power.prop.test()` now warns when it cannot solve the problem, typically because of impossible constraints. (PR#17345)
- `removeSource()` no longer erroneously removes `NULL` in certain cases, thanks to Dénes Tóth.
- `nls(` NO [mol/l]` ~ f(t))` and `nls(y ~ a)` now work. (Partly from PR#17367)
- `R CMD build` checks for GNU `cp` rather than assuming Linux has it. (PR#17370 says 'Alpine Linux' does not.)
- Non-UTF-8 multibyte character handling fixed more permanently (PR#16732).
- `sum(<large ints>,<stuff>)` is more consistent. (PR#17372)
- `rf()` and `rbeta()` now also work correctly when `ncp` is not scalar, notably when (partly) `NA`. (PR#17375)
- `is.na(NULL)` no longer warns. (PR#16107)
- `R CMD INSTALL` now correctly sets C++ compiler flags when all source files are in sub-directories of '`src`'.



CHANGES IN R 3.4.3

INSTALLATION on a UNIX-ALIKE:

- A workaround has been added for the changes in location of time-zone files in macOS 10.13 'High Sierra' and again in 10.13.1, so the default time zone is deduced correctly from the system setting when R is configured with '`--with-internal-tzcode`' (the default on macOS).
- `R CMD javareconf` has been updated to recognize the use of a Java 9 SDK on macOS.

BUG FIXES:

- `raw(0) & raw(0)` and `raw(0) | raw(0)` again return `raw(0)` (rather than `logical(0)`).

- `intToUtf8()` converts integers corresponding to surrogate code points to `NA` rather than invalid UTF-8, as well as values larger than the current Unicode maximum of `0x10FFFF`. (This aligns with the current RFC3629.)
- Fix calling of methods on S4 generics that dispatch on `...` when the call contains `....`
- Following Unicode 'Corrigendum 9', the UTF-8 representations of U+FFFE and U+FFFF are now regarded as valid by `utf8ToInt()`.
- `range(c(TRUE,NA),finite = TRUE)` and similar no longer return `NA`. (Reported by Lukas Stadler.)
- The self starting function `attr(SSlogis,"initial")` now also works when the y values have exact minimum zero and is slightly changed in general, behaving symmetrically in the y range.
- The printing of named raw vectors is now formatted nicely as for other such atomic vectors, thanks to Lukas Stadler.



CHANGES IN R 3.4.2

NEW FEATURES:

- Setting the `LC_ALL` category in `Sys.setlocale()` invalidates any cached locale-specific day/month names and the AM/PM indicator for `strptime()` (as setting `LC_TIME` has since R 3.1.0).
- The version of LAPACK included in the sources has been updated to 3.7.1, a bug-fix release.
- The default for `tools::write_PACKAGES(rds_compress=)` has been changed to `"xz"` to match the compression used by CRAN.
- `c()` and `unlist()` are now more efficient in constructing the `names(.)` of their return value, thanks to a proposal by Suharto Anggono. (PR#17284)

UTILITIES:

- `R CMD check` checks for and `R CMD build` corrects CRLF line endings in shell scripts `configure` and `cleanup` (even on Windows).

INSTALLATION on a UNIX-ALIKE:

- The order of selection of OpenMP flags has been changed: Oracle Developer Studio 12.5 accepts '`-fopenmp`' and '`-xopenmp`' but only the latter enables OpenMP so it is now tried first.

BUG FIXES:

- `within(List,rm(x1,x2))` works correctly again, including when `List[["x2"]]` is `NULL`.
- `regexec(pattern,text,*)` now applies `as.character(.)` to its first two arguments, as documented.
- `write.table()` and related functions, `writeLines()`, and perhaps other functions writing text to connections did not signal errors when the writes failed, e.g. due to a disk being full. Errors will now be signalled if detected during the write, warnings if detected when the connection is closed. (PR#17243)
- `rt()` assumed the `ncp` parameter was a scalar. (PR#17306)
- `menu(choices)` with more than 10 choices which easily fit into one `getOption("width")`-line no longer erroneously repeats choices. (PR#17312)

- `length()<-` on a pairlist succeeds. (https://stat.ethz.ch/pipermail/r-devel/2017-July/074680.html)
- Language objects such as `quote(("\n"))` or R functions are correctly printed again, where R 3.4.1 accidentally duplicated the backslashes.
- Construction of `names()` for very large objects in `c()` and `unlist()` now works, thanks to Suharto Anggono's patch proposals in PR#17292.
- Resource leaks (and similar) reported by Steve Grubb fixed. (PR#17314, PR#17316, PR#17317, PR#17318, PR#17319, PR#17320)
- `model.matrix(~1,mf)` now gets the row names from `mf` also when they differ from `1:nrow(mf)`, fixing PR#14992 thanks to the suggestion by Sebastian Meyer.
- `sigma(fm)` now takes the correct denominator degrees of freedom for a fitted model with `NA` coefficients. (PR#17313)
- `hist(x,"FD")` no longer "dies" with a somewhat cryptic error message when `x` has extreme outliers or `IQR()` zero: `nclass.FD(x)` tries harder to find a robust bin width h in the latter case, and `hist.default(*,breaks)` now checks and corrects a too large `breaks` number. (PR#17274)
- `callNextMethod()` works for `...` methods.
- `qr.coef(qd,y)` now has correct names also when `qd` is a complex QR or stems from `qr(*,LAPACK=TRUE)`.
- Setting `options(device = *)` to an invalid function no longer segfaults when plotting is initiated. (PR#15883)
- `encodeString(<very large string>)` no longer segfaults. (PR#15885)
- It is again possible to use `configure --enable-maintainer-mode` without having installed `notangle` (it was required in R 3.4.[01]).
- S4 method dispatch on `...` calls the method by name instead of `.Method` (for consistency with default dispatch), and only attempts to pass non-missing arguments from the generic.
- `readRDS(textConnection(.))` works again. (PR#17325)
- `(1:n)[-n]` no longer segfaults for `n <-2.2e9` (on a platform with enough RAM).
- `x <-1:2; tapply(x,list(x,x),function(x) "")[1,2]` now correctly returns `NA`. (PR#17333)
- Running of finalizers after explicit GC request moved from the R interface `do_gc` to the `C` interface `R_gc`. This helps with reclaiming inaccessible connections.
- `help.search(topic)` and `??topic` matching topics in vignettes with multiple file name extensions (e.g., '`*.md.rsp`' but not '`*.Rmd`') failed with an error when using `options(help_type = "html")`.
- The X11 device no longer uses the Xlib backing store (PR#16497).
- `array(character(),1)` now gives (a 1D array with) `NA` as has been documented for a long time as in the other cases of zero-length array initialization and also compatibly with `matrix(character(),*)`. As mentioned there, this also fixes PR#17333.
- `splineDesign(..,derivs = 4)` no longer segfaults.
- `fisher.test(*,hybrid=TRUE)` now (again) will use the hybrid method when Cochran's conditions are met, fixing PR#16654.



CHANGES IN R 3.4.1

INSTALLATION on a UNIX-ALIKE:

- The deprecated support for PCRE versions older than 8.20 has been removed.

BUG FIXES:

- `getParseData()` gave incorrect column information when code contained multi-byte characters. (PR#17254)
- Asking for help using expressions like `?stats::cor()` did not work. (PR#17250)
- `readRDS(url(....))` now works.
- `R CMD Sweave` again returns '`status = 0`' on successful completion.
- Vignettes listed in '`.Rbuildignore`' were not being ignored properly. (PR#17246)
- `file.mtime()` no longer returns NA on Windows when the file or directory is being used by another process. This affected `installed.packages()`, which is now protected against this.
- `R CMD INSTALL` Windows .zip file obeys `--lock` and `--pkglock` flags.
- (Windows only) The `choose.files()` function could return incorrect results when called with `multi = FALSE`. (PR#17270)
- `aggregate(<data.frame>,drop = FALSE)` now also works in case of near-equal numbers in `by`. (PR#16918)
- `fourfoldplot()` could encounter integer overflow when calculating the odds ratio. (PR#17286)
- `parse()` no longer gives spurious warnings when extracting srcrefs from a file not encoded in the current locale.
  This was seen from `R CMD check` with '`inst/doc/*.R`' files, and `check` has some additional protection for such files.
- `print.noquote(x)` now always returns its argument `x` (invisibly).
- Non-UTF-8 multibyte character sets were not handled properly in source references. (PR#16732)



CHANGES IN R 3.4.0

SIGNIFICANT USER-VISIBLE CHANGES:

- (Unix-alike) The default methods for `download.file()` and `url()` now choose `"libcurl"` except for '`file://`' URLs. There will be small changes in the format and wording of messages, including in rare cases if an issue is a warning or an error. For example, when HTTP re-direction occurs, some messages refer to the final URL rather than the specified one.
  Those who use proxies should check that their settings are compatible (see `?download.file`: the most commonly used forms work for both `"internal"` and `"libcurl"`).
- `table()` has been amended to be more internally consistent and become back compatible to R $\leq$ 2.7.2 again. Consequently, `table(1:2,exclude = NULL)` no longer contains a zero count for `<NA>`, but `useNA = "always"` continues to do so.
- `summary.default()` no longer rounds, but its print method does resulting in less extraneous rounding, notably of numbers in the ten thousands.
- `factor(x,exclude = L)` behaves more rationally when `x` or `L` are character vectors. Further, `exclude = <factor>` now behaves as documented for long.
- Arithmetic, logic (`&`, `|`) and comparison (aka 'relational', e.g., `<`, `==`) operations with arrays now behave consistently, notably for arrays of length zero.
  Arithmetic between length-1 arrays and longer non-arrays had silently dropped the array attributes and recycled. This now gives a warning and will signal an error in the future, as it has always for logic and comparison operations in these cases (e.g., compare `matrix(1,1) + 2:3` and `matrix(1,1) < 2:3`).

- The JIT ('Just In Time') byte-code compiler is now enabled by default at its level 3. This means functions will be compiled on first or second use and top-level loops will be compiled and then run. (Thanks to Tomas Kalibera for extensive work to make this possible.)
  For now, the compiler will not compile code containing explicit calls to `browser()`: this is to support single stepping from the `browser()` call.
  JIT compilation can be disabled for the rest of the session using `compiler::enableJIT(0)` or by setting environment variable `R_ENABLE_JIT` to `0`.
- `xtabs()` works more consistently with `NA`s, also in its result no longer setting them to `0`. Further, a new logical option `addNA` allows to count `NA`s where appropriate. Additionally, for the case `sparse = TRUE`, the result's `dimnames` are identical to the default case's.
- Matrix products now consistently bypass BLAS when the inputs have `NaN`/`Inf` values. Performance of the check of inputs has been improved. Performance when BLAS is used is improved for matrix/vector and vector/matrix multiplication (DGEMV is now used instead of DGEMM).
  One can now choose from alternative matrix product implementations *via* `options(matprod = )`. The `"internal"` implementation is not optimized for speed but consistent in precision with other summations in R (using `long double` accumulators where available). `"blas"` calls BLAS directly for best speed, but usually with undefined behavior for inputs with `NaN`/`Inf`.

NEW FEATURES:

- User errors such as `integrate(f,0:1,2)` are now caught.
- Add `signature` argument to `debug()`, `debugonce()`, `undebug()` and `isdebugged()` for more conveniently debugging S3 and S4 methods. (Based on a patch by Gabe Becker.)
- Add `utils::debugcall()` and `utils::undebugcall()` for debugging the function that would be called by evaluating the given expression. When the call is to an S4 generic or standard S3 generic, `debugcall()` debugs the method that would be dispatched. A number of internal utilities were added to support this, most notably `utils::isS3stdGeneric()`. (Based on a patch by Gabe Becker.)
- Add `utils::strcapture()`. Given a character vector and a regular expression containing capture expressions, `strcapture()` will extract the captured tokens into a tabular data structure, typically a `data.frame`.
- `str()` and `strOptions()` get a new option `drop.deparse.attr` with improved but *changed* default behaviour for expressions. For `expression` objects `x`, `str(x)` now may remove extraneous white space and truncate long lines.
- `str(<looooooooong_string>)` is no longer very slow; inspired by Mikko Korpela's proposal in PR#16527.
- `str(x)`'s default method is more "accurate" and hence somewhat more generous in displaying character vectors; this will occasionally change R outputs (and need changes to some '`*.Rout(.save)`' files).
  For a classed integer vector such as `x <-xtabs(~ c(1,9,9,9))`, `str(x)` now shows both the class and `"int"`, instead of only the latter.
- `isSymmetric(m)` is much faster for large asymmetric matrices `m` *via* pre-tests and a new option `tol1` (with which strict back compatibility is possible but not the default).
- The result of `eigen()` now is of class `"eigen"` in the default case when eigenvectors are computed.

- Zero-length date and date-time objects (of classes `"POSIX[cl]?t"`) now `print()` "recognizably".
- `xy.coords()` and `xyz.coords()` get a new `setLab` option.
- The `method` argument of `sort.list()`, `order()` and `sort.int()` gains an `"auto"` option (the default) which should behave the same as before when `method` was not supplied.
- `stopifnot(E,..)` now reports differences when `E` is a call to `all.equal()` and that is not true.
- `boxplot(<formula>,*)` gain optional arguments `drop`, `sep`, and `lex.order` to pass to `split.default()` which itself gains an argument `lex.order` to pass to `interaction()` for more flexibility.
- The `plot()` method for `ppr()` has enhanced default labels (`xmin` and `main`).
- `sample.int()` gains an explicit `useHash` option (with a back compatible default).
- `identical()` gains an `ignore.srcref` option which drops `"srcref"` and similar attributes when true (as by default).
- `diag(x,nrow = n)` now preserves `typeof(x)`, also for logical, integer and raw `x` (and as previously for complex and numeric).
- `smooth.spline()` now allows direct specification of `lambda`, gets a `hatvalues()` method and keeps `tol` in the result, and optionally parts of the internal matrix computations.
- `addNA()` is faster now, e.g. when applied twice. (Part of PR#16895.)
- New option `rstandard(<lm>,type = "predicted")` provides the "PRESS"–related leave-one-out cross-validation errors for linear models.
- After seven years of deprecation, duplicated factor levels now produce a warning when printed and an error in `levels<-` instead of a warning.
- Invalid factors, e.g., with duplicated levels (invalid but constructable) now give a warning when printed, *via* new function `.valid.factor()`.
- `sessionInfo()` has been updated for Apple's change in OS naming as from '10.12' ('macOS Sierra' *vs* 'OS X El Capitan').
  Its `toLatex()` method now includes the `running` component.
- `options(interrupt=)` can be used to specify a default action for user interrupts. For now, if this option is not set and the `error` option is set, then an unhandled user interrupt invokes the `error` option. (This may be dropped in the future as `interrupt` conditions are not `error` conditions.)
- In most cases user interrupt handlers will be called with a `"resume"` restart available. Handlers can invoke this restart to resume computation. At the browser prompt the `r` command will invoke a `"resume"` restart if one is available. Some read operations cannot be resumed properly when interrupted and do not provide a `"resume"` restart.
- Radix sort is now chosen by `method = "auto"` for `sort.int()` for double vectors (and hence used for `sort()` for unclassed double vectors), excluding 'long' vectors.
  `sort.int(method = "radix")` no longer rounds double vectors.
- The `default` and `data.frame` methods for `stack()` preserve the names of empty elements in the levels of the `ind` column of the return value. Set the new `drop` argument to `TRUE` for the previous behavior.
- Speedup in `simplify2array()` and hence `sapply()` and `mapply()` (for the case of names and common length ¿ 1), thanks to Suharto Anggono's PR#17118.
- `table(x,exclude = NULL)` now sets `useNA = "ifany"` (instead of `"always"`). Together with the bug fixes for this case, this recovers more consistent behaviour compatible to older versions of R. As a consequence, `summary()` for a logical vector no longer reports (zero) counts for `NA` when there are no `NA`s.

- `dump.frames()` gets a new option `include.GlobalEnv` which allows to also dump the global environment, thanks to Andreas Kersting's proposal in PR#17116.
- `system.time()` now uses `message()` instead of `cat()` when terminated early, such that `suppressMessages()` has an effect; suggested by Ben Bolker.
- `citation()` supports '`inst/CITATION`' files from package source trees, with `lib.loc` pointing to the directory containing the package.
- `try()` gains a new argument `outFile` with a default that can be modified *via* `options(try.outFile = .)`, useful notably for `Sweave`.
- The unexported low-level functions in package **parallel** for passing serialized R objects to and from forked children now support long vectors on 64-bit platforms. This removes some limits on higher-level functions such as `mclapply()` (but returning gigabyte results from forked processes *via* serialization should be avoided if at all possible).
- Connections now `print()` without error even if invalid, e.g. after having been destroyed.
- `apropos()` and `find(simple.words = FALSE)` no longer match object names starting with '`.`' which are known to be internal objects (such as `.__S3MethodsTable__.`).
- Convenience function `hasName()` has been added; it is intended to replace the common idiom `!is.null(x$name)` without the usually unintended partial name matching.
- `strcapture()` no longer fixes column names nor coerces strings to factors (suggested by Bill Dunlap).
- `strcapture()` returns `NA` for non-matching values in `x` (suggested by Bill Dunlap).
- `source()` gets new optional arguments, notably `exprs`; this is made use of in the new utility function `withAutoprint()`.
- `sys.source()` gets a new `toplevel.env` argument. This argument is useful for frameworks running package tests; contributed by Tomas Kalibera.
- `Sys.setFileTime()` and `file.copy(copy.date = TRUE)` will set timestamps with fractions of seconds on platforms/filesystems which support this.
- (Windows only.) `file.info()` now returns file timestamps including fractions of seconds; it has done so on other platforms since R 2.14.0. (NB: some filesystems do not record modification and access timestamps to sub-second resolution.)
- The license check enabled by `options(checkPackageLicense = TRUE)` is now done when the package's namespace is first loaded.
- `ppr()` and `supsmu()` get an optional `trace` argument, and `ppr(..,sm.method = ..spline)` is no longer limited to sample size $n \leq 2500$.
- The `POSIXct` method for `print()` gets optional `tz` and `usetz` arguments, thanks to a report from Jennifer S. Lyon.
- New function `check_packages_in_dir_details()` in package **tools** for analyzing package-check log files to obtain check details.
- Package **tools** now exports function `CRAN_package_db()` for obtaining information about current packages in the CRAN package repository, and several functions for obtaining the check status of these packages.
- The (default) Stangle driver `Rtangle` allows `annotate` to be a function and gets a new `drop.evalFALSE` option.
- The default method for `quantile(x,prob)` should now be monotone in `prob`, even in border cases, see PR#16672.
- `bug.report()` now tries to extract an email address from a '`BugReports`' field, and if there is none, from a '`Contacts`' field.

- The `format()` and `print()` methods for `object.size()` results get new options `standard` and `digits`; notably, `standard = "IEC"` and `standard = "SI"` allow more standard (but less common) abbreviations than the default ones, e.g. for kilobytes. (From contributions by Henrik Bengtsson.)
- If a reference class has a validity method, `validObject` will be called automatically from the default initialization method for reference classes.
- `tapply()` gets new option `default = NA` allowing to change the previously hardcoded value.
- `read.dcf()` now consistently interprets any 'whitespace' to be stripped to include newlines.
- The maximum number of DLLs that can be loaded into R e.g. *via* `dyn.load()` can now be increased by setting the environment variable `R_MAX_NUM_DLLS` before starting R.
- Assigning to an element of a vector beyond the current length now over-allocates by a small fraction. The new vector is marked internally as growable, and the true length of the new vector is stored in the `truelength` field. This makes building up a vector result by assigning to the next element beyond the current length more efficient, though pre-allocating is still preferred. The implementation is subject to change and not intended to be used in packages at this time.
- Loading the **parallel** package namespace no longer sets or changes the `.Random.seed`, even if `R_PARALLEL_PORT` is unset.
  NB: This can break reproducibility of output, and did for a CRAN package.
- Methods `"wget"` and `"curl"` for `download.file()` now give an R error rather than a non-zero return value when the external command has a non-zero status.
- Encoding name `"utf8"` is mapped to `"UTF-8"`. Many implementations of `iconv` accept `"utf8"`, but not GNU **libiconv** (including the late 2016 version 1.15).
- `sessionInfo()` shows the full paths to the library or executable files providing the BLAS/LAPACK implementations currently in use (not available on Windows).
- The binning algorithm used by bandwidth selectors `bw.ucv()`, `bw.bcv()` and `bw.SJ()` switches to a version linear in the input size `n` for `n > nb/2`. (The calculations are the same, but for larger `n/nb` it is worth doing the binning in advance.)
- There is a new option `PCRE_study` which controls when `grep(perl = TRUE)` and friends 'study' the compiled pattern. Previously this was done for 11 or more input strings: it now defaults to 10 or more (but most examples need many more for the difference from studying to be noticeable).
- `grep(perl = TRUE)` and friends can now make use of PCRE's Just-In-Time mechanism, for PCRE $\geq$ 8.20 on platforms where JIT is supported. It is used by default whenever the `pattern` is studied (see the previous item). (Based on a patch from Mikko Korpela.)
  This is controlled by a new option `PCRE_use_JIT`.
  Note that in general this makes little difference to the speed, and may take a little longer: its benefits are most evident on strings of thousands of characters. As a side effect it reduces the chances of C stack overflow in the PCRE library on very long strings (millions of characters, but see next item).
  Warning: segfaults were seen using PCRE with JIT enabled on 64-bit Sparc builds.
- There is a new option `PCRE_limit_recursion` for `grep(perl = TRUE)` and friends to set a recursion limit taking into account R's estimate of the remaining C stack space (or 10000 if that is not available). This reduces the chance of C stack overflow, but because it is conservative may report a non-match (with a warning) in examples that matched before. By default it is enabled if any input string has 1000 or more bytes. (PR#16757)

- `getGraphicsEvent()` now works on `X11(type = "cairo")` devices. Thanks to Frederick Eaton (for reviving an earlier patch).
- There is a new argument `onIdle` for `getGraphicsEvent()`, which allows an R function to be run whenever there are no pending graphics events. This is currently only supported on X11 devices. Thanks to Frederick Eaton.
- The `deriv()` and similar functions now can compute derivatives of `log1p()`, `sinpi()` and similar one-argument functions, thanks to a contribution by Jerry Lewis.
- `median()` gains a formal `...` argument, so methods with extra arguments can be provided.
- `strwrap()` reduces `indent` if it is more than half `width` rather than giving an error. (Suggested by Bill Dunlap.)
- When the condition `code` in `if(.)` or `while(.)` is not of length one, an error instead of a warning may be triggered by setting an environment variable, see the help page.
- Formatting and printing of bibliography entries (`bibentry`) is more flexible and better documented. Apart from setting `options(citation.bibtex.max = 99)` you can also use `print(<citation>,bibtex=TRUE)` (or `format(..)`) to get the BibTeX entries in the case of more than one entry. This also affects `citation()`. Contributions to enable `style = "html+bibtex"` are welcome.

C-LEVEL FACILITIES:

- Entry points `R_MakeExternalPtrFn` and `R_ExternalPtrFn` are now declared in header '`Rinternals.h`' to facilitate creating and retrieving an R external pointer from a C function pointer without ISO C warnings about the conversion of function pointers.
- There was an exception for the native Solaris C++ compiler to the dropping (in R 3.3.0) of legacy C++ headers from headers such as '`R.h`' and '`Rmath.h`' — this has now been removed. That compiler has strict C++98 compliance hence does not include extensions in its (non-legacy) C++ headers: some packages will need to request C++11 or replace non-C++98 calls such as `lgamma`: see §1.6.4 of 'Writing R Extensions'.
  Because it is needed by about 70 CRAN packages, headers '`R.h`' and '`Rmath.h`' still declare

  ```
  use namespace std;
  ```

  when included on Solaris.
- When included from C++, the R headers now use forms such as `std::FILE` directly rather than including the line

  ```
  using std::FILE;
  ```

  C++ code including these headers might be relying on the latter.
- Headers '`R_ext/BLAS.h`' and '`R_ext/Lapack.h`' have many improved declarations including `const` for double-precision complex routines. *Inter alia* this avoids warnings when passing 'string literal' arguments from C++11 code.
- Headers for Unix-only facilities '`R_ext/GetX11Image.h`', '`R_ext/QuartzDevice.h`' and '`R_ext/eventloop.h`' are no longer installed on Windows.
- No-longer-installed headers '`GraphicsBase.h`', '`RGraphics.h`', '`Rmodules/RX11.h`' and '`Rmodules/Rlapack.h`' which had a LGPL license no longer do so.
- `HAVE_UINTPTR_T` is now defined where appropriate by `Rconfig.h` so that it can be included before `Rinterface.h` when `CSTACK_DEFNS` is defined and a C compiler (not C++) is in use. `Rinterface.h` now includes C header '`stdint.h`' or C++11 header '`cstdint`' where needed.
- Package **tools** has a new function `package_native_routine_registration_skeleton()` to assist adding native-symbol registration to a package. See its help and §5.4.1 of

'Writing R Extensions' for how to use it. (At the time it was added it successfully automated adding registration to over 90% of CRAN packages which lacked it. Many of the failures were newly-detected bugs in the packages, e.g. 50 packages called entry points with varying numbers of arguments and 65 packages called entry points not in the package.)

INSTALLATION on a UNIX-ALIKE:

- `readline` headers (and not just the library) are required unless configuring with '`--with-readline=no`'.
- `configure` now adds a compiler switch for C++11 code, even if the compiler supports C++11 by default. (This ensures that `g++` 6.x uses C++11 mode and not its default mode of C++14 with 'GNU extensions'.)
  The tests for C++11 compliance are now much more comprehensive. For gcc ¡ 4.8, the tests from R 3.3.0 are used in order to maintain the same behaviour on Linux distributions with long-term support.
- An alternative compiler for C++11 is now specified with '`CXX11`', not '`CXX1X`'. Likewise C++11 flags are specified with '`CXX11FLAGS`' and the standard (e.g., '`-std=gnu++11`') is specified with '`CXX11STD`'.
- `configure` now tests for a C++14-compliant compiler by testing some basic features. This by default tries flags for the compiler specified by '`CXX11`', but an alternative compiler, options and standard can be specified by variables '`CXX14`', '`CXX14FLAGS`' and '`CXX14STD`' (e.g., '`-std=gnu++14`').
- There is a new macro `CXXSTD` to help specify the standard for C++ code, e.g. '`-std=c++98`'. This makes it easier to work with compilers which default to a later standard: for example, with `CXX=g++6 CXXSTD=-std=c++98 configure` will select commands for `g++` 6.x which conform to C++11 and C++14 where specified but otherwise use C++98.
- Support for the defunct IRIX and OSF/1 OSes and Alpha CPU has been removed.
- `configure` checks that the compiler specified by '`$CXX $CXXFLAGS`' is able to compile C++ code.
- `configure` checks for the required header '`sys/select.h`' (or '`sys/time.h`' on legacy systems) and system call `select` and aborts if they are not found.
- If available, the POSIX 2008 system call `utimensat` will be used by `Sys.setFileTime()` and `file.copy(copy.date = TRUE)`. This may result in slightly more accurate file times. (It is available on Linux and FreeBSD but not macOS.)
- The minimum version requirement for `libcurl` has been reduced to 7.22.0, although at least 7.28.0 is preferred and earlier versions are little tested. (This is to support Debian 7 'Wheezy' LTS and Ubuntu 'Precise' 12.04 LTS, although the latter is close to end-of-life.)
- `configure` tests for a C++17-compliant compiler. The tests are experimental and subject to change in the future.

INCLUDED SOFTWARE:

- (Windows only) Tcl/Tk version 8.6.4 is now included in the binary builds. The '`tcltk*.chm`' help file is no longer included; please consult the online help at http://www.tcl.tk/man/ instead.
- The version of LAPACK included in the sources has been updated to 3.7.0: no new routines have been added to R.

PACKAGE INSTALLATION:

- There is support for compiling C++14 or C++17 code in packages on suitable platforms: see 'Writing R Extensions' for how to request this.
- The order of flags when '`LinkingTo`' other packages has been changed so their include directories come earlier, before those specified in `CPPFLAGS`. This will only have an effect if non-system include directories are included with '`-I`' flags in `CPPFLAGS` (and so not the default `-I/usr/local/include` which is treated as a system include directory on most platforms).
- Packages which register native routines for `.C` or `.Fortran` need to be re-installed for this version (unless installed with R-devel SVN revision r72375 or later).
- Make variables with names containing `CXX1X` are deprecated in favour of those using `CXX11`, but for the time being are still made available *via* file '`etc/Makeconf`'. Packages using them should be converted to the new forms and made dependent on '`R (>= 3.4.0)`'.

UTILITIES:

- Running `R CMD check --as-cran` with `_R_CHECK_CRAN_INCOMING_REMOTE_` false now skips tests that require remote access. The remaining (local) tests typically run quickly compared to the remote tests.
- `R CMD build` will now give priority to vignettes produced from files in the '`vignettes`' directory over those in the '`inst/doc`' directory, with a warning that the latter are being ignored.
- `R CMD config` gains a '`--all`' option for printing names and values of all basic configure variables.
  It now knows about all the variables used for the C++98, C++11 and C++14 standards.
- `R CMD check` now checks that output files in '`inst/doc`' are newer than the source files in '`vignettes`'.
- For consistency with other package subdirectories, files named '`*.r`' in the '`tests`' directory are now recognized as tests by `R CMD check`. (Wish of PR#17143.)
- `R CMD build` and `R CMD check` now use the *union* of `R_LIBS` and `.libPaths()`. They may not be equivalent, e.g., when the latter is determined by `R_PROFILE`.
- `R CMD build` now preserves dates when it copies files in preparing the tarball. (Previously on Windows it changed the dates on all files; on Unix, it changed some dates when installing vignettes.)
- The new option `R CMD check --no-stop-on-test-error` allows running the remaining tests (under '`tests/`') even if one gave an error.
- Check customization *via* environment variables to detect side effects of `.Call()` and `.External()` calls which alter their arguments is described in §8 of the 'R Internals' manual.
- `R CMD check` now checks any '`BugReports`' field to be non-empty and a suitable single URL.
- `R CMD check --as-cran` now NOTEs if the package does not register its native routines or does not declare its intentions on (native) symbol search. (This will become a WARNING in due course.)

DEPRECATED AND DEFUNCT:

- (Windows only) Function `setInternet2()` is defunct.
- Installation support for `readline` emulations based on `editline` (aka `libedit`) is deprecated.
- Use of the C/C++ macro '`NO_C_HEADERS`' is defunct and silently ignored.

- `unix.time()`, a traditional synonym for `system.time()`, has been deprecated.
- `structure(NULL,..)` is now deprecated as you cannot set attributes on `NULL`.
- Header '`Rconfig.h`' no longer defines '`SUPPORT_OPENMP`'; instead use '`_OPENMP`' (as documented for a long time).
- (C-level Native routine registration.) The deprecated `styles` member of the `R_CMethodDef` and `R_FortranMethodDef` structures has been removed. Packages using these will need to be re-installed for R 3.4.0.
- The deprecated support for PCRE versions older than 8.20 will be removed in R 3.4.1. (Versions 8.20–8.31 will still be accepted but remain deprecated.)

BUG FIXES:

- Getting or setting `body()` or `formals()` on non-functions for now signals a warning and may become an error for setting.
- `match(x,t)`, `duplicated(x)` and `unique(x)` work as documented for complex numbers with `NA`s or `NaN`s, where all those containing `NA` do match, whereas in the case of `NaN`'s both real and imaginary parts must match, compatibly with how `print()` and `format()` work for complex numbers.
- `deparse(<complex>,options = "digits17")` prints more nicely now, mostly thanks to a suggestion by Richie Cotton.
- Rotated symbols in plotmath expressions are now positioned correctly on `x11(type = "Xlib")`. (PR#16948)
- `as<-()` avoids an infinite loop when a virtual class is interposed between a subclass and an actual superclass.
- Fix level propagation in `unlist()` when the list contains zero-length lists or factors.
- Fix S3 dispatch on S4 objects when the **methods** package is not attached.
- Internal S4 dispatch sets `.Generic` in the method frame for consistency with `standardGeneric()`. (PR#16929)
- Fix `order(x,decreasing = TRUE)` when `x` is an integer vector containing `MAX_INT`. Ported from a fix Matt Dowle made to **data.table**.
- Fix caching by `callNextMethod()`, resolves PR#16973 and PR#16974.
- `grouping()` puts NAs last, to be consistent with the default behavior of `order()`.
- Point mass limit cases: `qpois(-2,0)` now gives `NaN` with a warning and `qgeom(1,1)` is `0`. (PR#16972)
- `table()` no longer drops an `"NaN"` factor level, and better obeys `exclude = <chr>`, thanks to Suharto Anggono's patch for PR#16936. Also, in the case of `exclude = NULL` and `NA`s, these are tabulated correctly (again).
  Further, `table(1:2,exclude = 1,useNA = "ifany")` no longer erroneously reports `<NA>` counts.
  Additionally, all cases of empty `exclude` are equivalent, and `useNA` is not overwritten when specified (as it was by `exclude = NULL`).
- `wilcox.test(x,conf.int=TRUE)` no longer errors out in cases where the confidence interval is not available, such as for `x = 0:2`.
- `droplevels(f)` now keeps ¡NA¿ levels when present.
- In integer arithmetic, `NULL` is now treated as `integer(0)` whereas it was previously treated as `double(0)`.
- The radix sort considers `NA_real_` and `NaN` to be equivalent in rank (like the other sort algorithms).
- When `index.return=TRUE` is passed to `sort.int()`, the radix sort treats `NA`s like `sort.list()` does (like the other sort algorithms).

- When in `tabulate(bin,nbin)` `length(bin)` is larger than the maximal integer, the result is now of type `double` and hence no longer silently overflows to wrong values. (PR#17140)
- `as.character.factor()` respects S4 inheritance when checking the type of its argument. (PR#17141)
- The `factor` method for `print()` no longer sets the class of the factor to `NULL`, which would violate a basic constraint of an S4 object.
- `formatC(x,flag = f)` allows two new flags, and signals an error for invalid flags also in the case of character formatting.
- Reading from `file("stdin")` now also closes the connection and hence no longer leaks memory when reading from a full pipe, thanks to Gábor Csárdi, see thread starting at https://stat.ethz.ch/pipermail/r-devel/2016-November/073360.html.
- Failure to create file in `tempdir()` for compressed `pdf()` graphics device no longer errors (then later segfaults). There is now a warning instead of error and compression is turned off for the device. Thanks to Alec Wysoker (PR#17191).
- Asking for `methods()` on `"|"` returns only S3 methods. See https://stat.ethz.ch/pipermail/r-devel/2016-December/073476.html.
- `dev.capture()` using Quartz Cocoa device (macOS) returned invalid components if the back-end chose to use ARGB instead of RGBA image format. (Reported by Noam Ross.)
- `seq("2","5")` now works too, equivalently to `"2":"5"` and `seq.int()`.
- `seq.int(to = 1,by = 1)` is now correct, other cases are integer (instead of `double`) when `seq()` is integer too, and the "non-finite" error messages are consistent between `seq.default()` and `seq.int()`, no longer mentioning `NaN` etc.
- `rep(x,times)` and `rep.int(x,times)` now work when `times` is larger than the largest value representable in an integer vector. (PR#16932)
- `download.file(method = "libcurl")` does not check for URL existence before attempting downloads; this is more robust to servers that do not support HEAD or range-based retrieval, but may create empty or incomplete files for aborted download requests.
- Bandwidth selectors `bw.ucv()`, `bw.bcv()` and `bw.SJ()` now avoid integer overflow for large sample sizes.
- `str()` no longer shows `"list output truncated"`, in cases that list was not shown at all. Thanks to Neal Fultz (PR#17219)
- Fix for `cairo_pdf()` (and `svg()` and `cairo_ps()`) when replaying a saved display list that contains a mix of **grid** and **graphics** output. (Report by Yihui Xie.)
- The `str()` and `as.hclust()` methods for `"dendrogram"` now also work for deeply nested dendrograms thanks to non-recursive implementations by Bradley Broom.
- `sample()` now uses two uniforms for added precision when the uniform generator is `Knuth-TAOCP`, `Knuth-TAOCP-2002`, or a user-defined generator and the population size is 2^{25} or greater.
- If a vignette in the '`vignettes`' directory is listed in '`.Rbuildignore`', `R CMD build` would not include it in the tarball, but would include it in the vignette database, leading to a check warning. (PR#17246)
- `tools::latexToUtf8()` infinite looped on certain inputs. (PR#17138)
- `terms.formula()` ignored argument names when determining whether two terms were identical. (PR#17235)
- `callNextMethod()` was broken when called from a method that augments the formal arguments of a primitive generic.

- Coercion of an S4 object to a vector during sub-assignment into a vector failed to dispatch through the `as.vector()` generic (often leading to a segfault).
- Fix problems in command completion: Crash (PR#17222) and junk display in Windows, handling special characters in filenames on all systems.



CHANGES IN R 3.3.3

NEW FEATURES:

- Changes when redirection of a '`http://`' URL to a '`https://`' URL is encountered:
  - The internal methods of `download.file()` and `url()` now report that they cannot follow this (rather than failing silently).
  - (Unix-alike) `download.file(method = "auto")` (the default) re-tries with `method = "libcurl"`.
  - (Unix-alike) `url(method = "default")` with an explicit `open` argument re-tries with `method = "libcurl"`. This covers many of the usages, e.g. `readLines()` with a URL argument.

INSTALLATION on a UNIX-ALIKE:

- The `configure` check for the `zlib` version is now robust to versions longer than 5 characters, including `1.2.11`.

UTILITIES:

- Environmental variable `_R_CHECK_TESTS_NLINES_` controls how `R CMD check` reports failing tests (see §8 of the 'R Internals' manual).

DEPRECATED AND DEFUNCT:

- (C-level Native routine registration.) The undocumented `styles` field of the components of `R_CMethodDef` and `R_FortranMethodDef` is deprecated.

BUG FIXES:

- `vapply(x,*)` now works with long vectors `x`. (PR#17174)
- `isS3method("is.na.data.frame")` and similar are correct now. (PR#17171)
- `grepRaw(<long>,<short>,fixed = TRUE)` now works, thanks to a patch by Mikko Korpela. (PR#17132)
- Package installation into a library where the package exists *via* symbolic link now should work wherever `Sys.readlink()` works, resolving PR#16725.
- `"Cincinnati"` was missing an `"n"` in the `precip` dataset.
- Fix buffer overflow vulnerability in `pdf()` when loading an encoding file. Reported by Talos (TALOS-2016-0227).
- `getDLLRegisteredRoutines()` now produces its warning correctly when multiple DLLs match, thanks to Matt Dowle's PR#17184.
- `Sys.timezone()` now returns non-NA also on platforms such as '`Ubuntu 14.04.5 LTS`', thanks to Mikko Korpela's PR#17186.
- `format(x)` for an illegal `"POSIXlt"` object `x` no longer segfaults.
- `methods(f)` now also works for `f "("` or `"{"`.
- (Windows only) `dir.create()` did not check the length of the path to create, and so could overflow a buffer and crash R. (PR#17206)
- On some systems, very small hexadecimal numbers in hex notation would underflow to zero. (PR#17199)

- `pmin()` and `pmax()` now work again for `ordered` factors and 0-length S3 classed objects, thanks to Suharto Anggono's PR#17195 and PR#17200.
- `bug.report()` did not do any validity checking on a package's '`BugReports`' field. It now ignores an empty field, removes leading whitespace and only attempts to open '`http://`' and '`https://`' URLs, falling back to emailing the maintainer.
- Bandwidth selectors `bw.ucv()` and `bw.SJ()` gave incorrect answers or incorrectly reported an error (because of integer overflow) for inputs longer than 46341. Similarly for `bw.bcv()` at length 5793.
  Another possible integer overflow is checked and may result in an error report (rather than an incorrect result) for much longer inputs (millions for a smooth distribution).
- `findMethod()` failed if the active signature had expanded beyond what a particular package used. (Example with packages **XR** and **XRJulia** on CRAN.)
- `qbeta()` underflowed too early in some very asymmetric cases. (PR#17178)
- `R CMD Rd2pdf` had problems with packages with non-ASCII titles in '`.Rd`' files (usually the titles were omitted).



CHANGES IN R 3.3.2

NEW FEATURES:

- `extSoftVersion()` now reports the version (if any) of the `readline` library in use.
- The version of LAPACK included in the sources has been updated to 3.6.1, a bug-fix release including a speedup for the non-symmetric case of `eigen()`.
- Use `options(deparse.max.lines=)` to limit the number of lines recorded in `.Traceback` and other deparsing activities.
- `format(<AsIs>)` looks more regular, also for non-character atomic matrices.
- `abbreviate()` gains an option `named = TRUE`.
- The online documentation for package **methods** is extensively rewritten. The goals are to simplify documentation for basic use, to note old features not recommended and to correct out-of-date information.
- Calls to `setMethod()` no longer print a message when creating a generic function in those cases where that is natural: S3 generics and primitives.

INSTALLATION and INCLUDED SOFTWARE:

- Versions of the `readline` library ¿= 6.3 had been changed so that terminal window resizes were not signalled to `readline`: code has been added using a explicit signal handler to work around that (when R is compiled against readline ¿= 6.3). (PR#16604)
- `configure` works better with Oracle Developer Studio 12.5.

UTILITIES:

- `R CMD check` reports more dubious flags in files '`src/Makevars[.in]`', including '`-w`' and '`-g`'.
- `R CMD check` has been set up to filter important warnings from recent versions of `gfortran` with '`-Wall -pedantic`': this now reports non-portable GNU extensions such as out-of-order declarations.
- `R CMD config` works better with paths containing spaces, even those of home directories (as reported by Ken Beath).

DEPRECATED AND DEFUNCT:

- Use of the C/C++ macro '`NO_C_HEADERS`' is deprecated (no C headers are included by R headers from C++ as from R 3.3.0, so it should no longer be needed).

BUG FIXES:

- The check for non-portable flags in `R CMD check` could be stymied by '`src/Makevars`' files which contained targets.
- (Windows only) When using certain desktop themes in Windows 7 or higher, *`Alt-Tab`* could cause `Rterm` to stop accepting input. (PR#14406; patch submitted by Jan Gleixner.)
- `pretty(d,..)` behaves better for date-time `d` (PR#16923).
- When an S4 class name matches multiple classes in the S4 cache, perform a dynamic search in order to obey namespace imports. This should eliminate annoying messages about multiple hits in the class cache. Also, pass along the package from the `ClassExtends` object when looking up superclasses in the cache.
- `sample(NA_real_)` now works.
- Packages using non-ASCII encodings in their code did not install data properly on systems using different encodings.
- `merge(df1,df2)` now also works for data frames with column names `"na.last"`, `"decreasing"`, or `"method"`. (PR#17119)
- `contour()` caused a segfault if the `labels` argument had length zero. (Reported by Bill Dunlap.)
- `unique(warnings())` works more correctly, thanks to a new `duplicated.warnings()` method.
- `findInterval(x,vec = numeric(),all.inside = TRUE)` now returns 0s as documented. (Reported by Bill Dunlap.)
- (Windows only) `R CMD SHLIB` failed when a symbol in the resulting library had the same name as a keyword in the '`.def`' file. (PR#17130)
- `pmax()` and `pmin()` now work with (more ?) classed objects, such as `"Matrix"` from the **Matrix** package, as documented for a long time.
- `axis(side,x = D)` and hence `Axis()` and `plot()` now work correctly for `"Date"` and time objects `D`, even when "time goes backward", e.g., with decreasing `xlim`. (Reported by William May.)
- `str(I(matrix(..)))` now looks as always intended.
- `plot.ts()`, the `plot()` method for time series, now respects `cex`, `lwd` and `lty`. (Reported by Greg Werbin.)
- `parallel::mccollect()` now returns a named list (as documented) when called with `wait = FALSE`. (Reported by Michel Lang.)
- If a package added a class to a class union in another package, loading the first package gave erroneous warnings about "undefined subclass".
- `c()`'s argument `use.names` is documented now, as belonging to the (C internal) default method. In "parallel", argument `recursive` is also moved from the generic to the default method, such that the formal argument list of **base** generic `c()` is just `(...)`.
- `rbeta(4,NA)` and similarly `rgamma()` and `rnbinom()` now return `NaN`'s with a warning, as other r¡dist¿(), and as documented. (PR#17155)
- Using `options(checkPackageLicense = TRUE)` no longer requires acceptance of the licence for non-default standard packages such as **compiler**. (Reported by Mikko Korpela.)
- `split(<very_long>,*)` now works even when the split off parts are long. (PR#17139)

- `min()` and `max()` now also work correctly when the argument list starts with `character(0)`. (PR#17160)
- Subsetting very large matrices (`prod(dim(.)) >= 2^31`) now works thanks to Michael Schubmehl's PR#17158.
- `bartlett.test()` used residual sums of squares instead of variances, when the argument was a list of `lm` objects. (Reported by Jens Ledet Jensen).
- `plot(<lm>,which = *)` now correctly labels the contour lines for the standardized residuals for `which = 6`. It also takes the correct p in case of singularities (also for `which = 5`). (PR#17161)
- `xtabs(~ exclude)` no longer fails from wrong scope, thanks to Suharto Anggono's PR#17147.
- Reference class calls to `methods()` did not re-analyse previously defined methods, meaning that calls to methods defined later would fail. (Reported by Charles Tilford).
- `findInterval(x,vec,left.open = TRUE)` misbehaved in some cases. (Reported by Dmitriy Chernykh.)



CHANGES IN R 3.3.1

BUG FIXES:

- `R CMD INSTALL` and hence `install.packages()` gave an internal error installing a package called **description** from a tarball on a case-insensitive file system.
- `match(x,t)` (and hence `x %in% t`) failed when `x` was of length one, and either `character` and `x` and `t` only differed in their `Encoding` or when `x` and `t` where `complex` with `NA`s or `NaN`s. (PR#16885.)
- `unloadNamespace(ns)` also works again when `ns` is a 'namespace', as from `getNamespace()`.
- `rgamma(1,Inf)` or `rgamma(1,0,0)` no longer give `NaN` but the correct limit.
- `length(baseenv())` is correct now.
- `pretty(d,..)` for date-time `d` rarely failed when `"halfmonth"` time steps were tried (PR#16923) and on 'inaccurate' platforms such as 32-bit Windows or a configuration with `--disable-long-double`; see comment #15 of PR#16761.
- In `text.default(x,y,labels)`, the rarely(?) used default for `labels` is now correct also for the case of a 2-column matrix `x` and missing `y`.
- `as.factor(c(a = 1L))` preserves `names()` again as in R ¡ 3.1.0.
- `strtrim(""[0],0[0])` now works.
- Use of `Ctrl-C` to terminate a reverse incremental search started by `Ctrl-R` in the `readline`-based Unix terminal interface is now supported when R was compiled against `readline` ¿= 6.0 (`Ctrl-G` always worked). (PR#16603)
- `diff(<difftime>)` now keeps the `"units"` attribute, as subtraction already did, PR#16940.



CHANGES IN R 3.3.0

SIGNIFICANT USER-VISIBLE CHANGES:

- `nchar(x,*)`'s argument `keepNA` governing how the result for `NA`s in `x` is determined, gets a new default `keepNA = NA` which returns `NA` where `x` is `NA`, except for `type = "width"` which still returns `2`, the formatting / printing width of `NA`.

- All builds have support for '`https:`' URLs in the default methods for `download.file()`, `url()` and code making use of them.
  Unfortunately that cannot guarantee that any particular '`https:`' URL can be accessed. For example, server and client have to successfully negotiate a cryptographic protocol (TLS/SSL, ...) and the server's identity has to be verifiable *via* the available certificates. Different access methods may allow different protocols or use private certificate bundles: we encountered a '`https:`' CRAN mirror which could be accessed by one browser but not by another nor by `download.file()` on the same Linux machine.

NEW FEATURES:

- The `print` method for `methods()` gains a `byclass` argument.
- New functions `validEnc()` and `validUTF8()` to give access to the validity checks for inputs used by `grep()` and friends.
- Experimental new functionality for S3 method checking, notably `isS3method()`.
  Also, the names of the R 'language elements' are exported as character vector `tools::langElts`.
- `str(x)` now displays `"Time-Series"` also for matrix (multivariate) time-series, i.e. when `is.ts(x)` is true.
- (Windows only) The GUI menu item to install local packages now accepts '`*.tar.gz`' files as well as '`*.zip`' files (but defaults to the latter).
- New programmeR's utility function `chkDots()`.
- `D()` now signals an error when given invalid input, rather than silently returning `NA`. (Request of John Nash.)
- `formula` objects are slightly more "first class": e.g., `formula()` or `new("formula",y ~ x)` are now valid. Similarly, for `"table"`, `"ordered"` and `"summary.table"`. Packages defining S4 classes with the above S3/S4 classes as slots should be reinstalled.
- New function `strrep()` for repeating the elements of a character vector.
- `rapply()` preserves attributes on the list when `how = "replace"`.
- New S3 generic function `sigma()` with methods for extracting the estimated standard deviation aka "residual standard deviation" from a fitted model.
- `news()` now displays R and package news files within the HTML help system if it is available. If no news file is found, a visible `NULL` is returned to the console.
- `as.raster(x)` now also accepts `raw` arrays `x` assuming values in `0:255`.
- Subscripting of matrix/array objects of type `"expression"` is now supported.
- `type.convert("i")` now returns a factor instead of a complex value with zero real part and missing imaginary part.
- Graphics devices `cairo_pdf()` and `cairo_ps()` now allow non-default values of the cairographics 'fallback resolution' to be set.
  This now defaults to 300 on all platforms: that is the default documented by cairographics, but apparently was not used by all system installations.
- `file()` gains an explicit `method` argument rather than implicitly using `getOption("url.method","default")`.
- Thanks to a patch from Tomas Kalibera, `x[x != 0]` is now typically faster than `x[which(x != 0)]` (in the case where `x` has no NAs, the two are equivalent).
- `read.table()` now always uses the names for a named `colClasses` argument (previously names were only used when `colClasses` was too short). (In part, wish of PR#16478.)
- (Windows only) `download.file()` with default `method = "auto"` and a '`ftps://`' URL chooses `"libcurl"` if that is available.

- The out-of-the box Bioconductor mirror has been changed to one using 'https://': use chooseBioCmirror() to choose a 'http://' mirror if required.
- The data frame and formula methods for aggregate() gain a drop argument.
- available.packages() gains a repos argument.
- The undocumented switching of methods for url() on 'https:' and 'ftps:' URLs is confined to method = "default" (and documented).
- smoothScatter() gains a ret.selection argument.
- qr() no longer has a ... argument to pass additional arguments to methods.
- [has a method for class "table".
- It is now possible (again) to replayPlot() a display list snapshot that was created by recordPlot() in a different R session.
  It is still not a good idea to use snapshots as a persistent storage format for R plots, but it is now not completely silly to use a snapshot as a format for transferring an R plot between two R sessions.
  The underlying changes mean that packages providing graphics devices (e.g., **Cairo**, **RSvgDevice**, **cairoDevice**, **tikzDevice**) will need to be reinstalled.
  Code for restoring snapshots was contributed by Jeroen Ooms and JJ Allaire.
  Some testing code is available at https://github.com/pmur002/R-display-list.
- tools::undoc(dir = D) and codoc(dir = D) now also work when D is a directory whose normalizePath()ed version does not end in the package name, e.g. from a symlink.
- abbreviate() has more support for multi-byte character sets – it no longer removes bytes within characters and knows about Latin vowels with accents. It is still only really suitable for (most) European languages, and still warns on non-ASCII input.
  abbreviate(use.classes = FALSE) is now implemented, and that is more suitable for non-European languages.
- match(x,table) is faster (sometimes by an order of magnitude) when x is of length one and incomparables is unchanged, thanks to Peter Haverty (PR#16491).
- More consistent, partly not back-compatible behavior of NA and NaN coercion to complex numbers, operations less often resulting in complex NA (NA_complex_).
- lengths() considers methods for length and [[on x, so it should work automatically on any objects for which appropriate methods on those generics are defined.
- The logic for selecting the default screen device on OS X has been simplified: it is now quartz() if that is available even if environment variable DISPLAY has been set by the user.
  The choice can easily be overridden *via* environment variable R_INTERACTIVE_DEVICE.
- On Unix-like platforms which support the getline C library function, system(*,intern = TRUE) no longer truncates (output) lines longer than 8192 characters, thanks to Karl Millar. (PR#16544)
- rank() gains a ties.method = "last" option, for convenience (and symmetry).
- regmatches(invert = NA) can now be used to extract both non-matched and matched substrings.
- data.frame() gains argument fix.empty.names; as.data.frame.list() gets new cut.names, col.names and fix.empty.names.
- plot(x ~ x,*) now warns that it is the same as plot(x ~ 1,*).
- recordPlot() has new arguments load and attach to allow package names to be stored as part of a recorded plot. replayPlot() has new argument reloadPkgs to load/attach any package names that were stored as part of a recorded plot.
- S4 dispatch works within calls to .Internal(). This means explicit S4 generics are no longer needed for unlist() and as.vector().

- Only font family names starting with '`"Hershey"`' (and not '`"Her"`' as before) are given special treatment by the graphics engine.
- S4 values are automatically coerced to vector (*via* `as.vector`) when subassigned into atomic vectors.
- `findInterval()` gets a `left.open` option.
- The version of LAPACK included in the sources has been updated to 3.6.0, including those 'deprecated' routines which were previously included. *Ca* 40 double-complex routines have been added at the request of a package maintainer.
  As before, the details of what is included are in '`src/modules/lapack/README`' and this now gives information on earlier additions.
- `tapply()` has been made considerably more efficient without changing functionality, thanks to proposals from Peter Haverty and Suharto Anggono. (PR#16640)
- `match.arg(arg)` (the one-argument case) is faster; so is `sort.int()`. (PR#16640)
- The `format` method for `object_size` objects now also accepts "binary" units such as `"KiB"` and e.g., `"Tb"`. (Partly from PR#16649.)
- Profiling now records calls of the form `foo::bar` and some similar cases directly rather than as calls to `<Anonymous>`. Contributed by Winston Chang.
- New string utilities `startsWith(x,prefix)` and `endsWith(x,suffix)`. Also provide speedups for some `grepl("^...",*)` uses (related to proposals in PR#16490).
- Reference class finalizers run at exit, as well as on garbage collection.
- Avoid **parallel** dependency on **stats** for port choice and random number seeds. (PR#16668)
- The radix sort algorithm and implementation from **data.table** (`forder`) replaces the previous radix (counting) sort and adds a new method for `order()`. Contributed by Matt Dowle and Arun Srinivasan, the new algorithm supports logical, integer (even with large values), real, and character vectors. It outperforms all other methods, but there are some caveats (see `?sort`).
- The `order()` function gains a `method` argument for choosing between `"shell"` and `"radix"`.
- New function `grouping()` returns a permutation that stably rearranges data so that identical values are adjacent. The return value includes extra partitioning information on the groups. The implementation came included with the new radix sort.
- `rhyper(nn,m,n,k)` no longer returns `NA` when one of the three parameters exceeds the maximal integer.
- `switch()` now warns when no alternatives are provided.
- `parallel::detectCores()` now has default `logical = TRUE` on all platforms – as this was the default on Windows, this change only affects Sparc Solaris.
  Option `logical = FALSE` is now supported on Linux and recent versions of OS X (for the latter, thanks to a suggestion of Kyaw Sint).
- `hist()` for `"Date"` or `"POSIXt"` objects would sometimes give misleading labels on the breaks, as they were set to the day before the start of the period being displayed. The display format has been changed, and the shift of the start day has been made conditional on `right = TRUE` (the default). (PR#16679)
- R now uses a new version of the logo (donated to the R Foundation by RStudio). It is defined in '`.svg`' format, so will resize without unnecessary degradation when displayed on HTML pages—there is also a vector PDF version. Thanks to Dirk Eddelbuettel for producing the corresponding X11 icon.
- New function `.traceback()` returns the stack trace which `traceback()` prints.
- `lengths()` dispatches internally.

- `dotchart()` gains a `pt.cex` argument to control the size of points separately from the size of plot labels. Thanks to Michael Friendly and Milan Bouchet-Valat for ideas and patches.
- `as.roman(ch)` now correctly deals with more diverse character vectors `ch`; also arithmetic with the resulting roman numbers works in more cases. (PR#16779)
- `prcomp()` gains a new option `rank.` allowing to directly aim for less than `min(n,p)` PC's. The `summary()` and its `print()` method have been amended, notably for this case.
- `gzcon()` gains a new option `text`, which marks the connection as text-oriented (so e.g. `pushBack()` works). It is still always opened in binary mode.
- The `import()` namespace directive now accepts an argument `except` which names symbols to exclude from the imports. The `except` expression should evaluate to a character vector (after substituting symbols for strings). See Writing R Extensions.
- New convenience function `Rcmd()` in package **tools** for invoking `R CMD` tools from within R.
- New functions `makevars_user()` and `makevars_site()` in package **tools** to determine the location of the user and site specific '`Makevars`' files for customizing package compilation.

UTILITIES:

- `R CMD check` has a new option '`--ignore-vignettes`' for use with non-Sweave vignettes whose '`VignetteBuilder`' package is not available.
- `R CMD check` now by default checks code usage (*via* **codetools**) with only the base package attached. Functions from default packages other than **base** which are used in the package code but not imported are reported as undefined globals, with a suggested addition to the `NAMESPACE` file.
- `R CMD check --as-cran` now also checks DOIs in package '`CITATION`' and Rd files.
- `R CMD Rdconv` and `R CMD Rd2pdf` each have a new option '`--RdMacros=pkglist`' which allows Rd macros to be specified before processing.

DEPRECATED AND DEFUNCT:

- The previously included versions of `zlib`, `bzip2`, `xz` and PCRE have been removed, so suitable external (usually system) versions are required (see the 'R Installation and Administration' manual).
- The unexported and undocumented Windows-only devices `cairo_bmp()`, `cairo_png()` and `cairo_tiff()` have been removed. (These devices should be used as e.g. `bmp(type = "cairo")`.)
- (Windows only) Function `setInternet2()` has no effect and will be removed in due course. The choice between methods `"internal"` and `"wininet"` is now made by the `method` arguments of `url()` and `download.file()` and their defaults can be set *via* options. The out-of-the-box default remains `"wininet"` (as it has been since R 3.2.2).
- `[<-` with an S4 value into a list currently embeds the S4 object into its own list such that the end result is roughly equivalent to using `[[<-`. That behavior is deprecated. In the future, the S4 value will be coerced to a list with `as.list()`.
- Package **tools**' functions `package.dependencies()`, `pkgDepends()`, etc are deprecated now, mostly in favor of `package_dependencies()` which is both more flexible and efficient.

INSTALLATION and INCLUDED SOFTWARE:

- Support for very old versions of `valgrind` (e.g., 3.3.0) has been removed.

- The included `libtool` script (generated by `configure`) has been updated to version 2.4.6 (from 2.2.6a).
- `libcurl` version 7.28.0 or later with support for the `https` protocol is required for installation (except on Windows).
- BSD networking is now required (except on Windows) and so `capabilities("http/ftp")` is always true.
- `configure` uses `pkg-config` for PNG, TIFF and JPEG where this is available. This should work better with multiple installs and with those using static libraries.
- The minimum supported version of OS X is 10.6 ('Snow Leopard'): even that has been unsupported by Apple since 2012.
- The `configure` default on OS X is '`--disable-R-framework`': enable this if you intend to install under '`/Library/Frameworks`' and use with `R.app`.
- The minimum preferred version of PCRE has since R 3.0.0 been 8.32 (released in Nov 2012). Versions 8.10 to 8.31 are now deprecated (with warnings from `configure`), but will still be accepted until R 3.4.0.
- `configure` looks for C functions `__cospi`, `__sinpi` and `__tanpi` and uses these if `cospi` *etc* are not found. (OS X is the main instance.)
- (Windows) R is now built using `gcc` 4.9.3. This build will require recompilation of at least those packages that include C++ code, and possibly others. A build of R-devel using the older toolchain will be temporarily available for comparison purposes.
  During the transition, the environment variable `R_COMPILED_BY` has been defined to indicate which toolchain was used to compile R (and hence, which should be used to compile code in packages). The `COMPILED_BY` variable described below will be a permanent replacement for this.
- (Windows) A `make` and `R CMD config` variable named `COMPILED_BY` has been added. This indicates which toolchain was used to compile R (and hence, which should be used to compile code in packages).

PACKAGE INSTALLATION:

- The `make` macro `AWK` which used to be made available to files such as '`src/Makefile`' is no longer set.

C-LEVEL FACILITIES:

- The API call `logspace_sum` introduced in R 3.2.0 is now remapped as an entry point to `Rf_logspace_sum`, and its first argument has gained a `const` qualifier. (PR#16470)
  Code using it will need to be reinstalled.
  Similarly, entry point `log1pexp` also defined in '`Rmath.h`' is remapped there to `Rf_log1pexp`
- `R_GE_version` has been increased to `11`.
- New API call `R_orderVector1`, a faster one-argument version of `R_orderVector`.
- When R headers such as '`R.h`' and '`Rmath.h`' are called from C++ code in packages they include the C++ versions of system headers such as '`<cmath>`' rather than the legacy headers such as '`<math.h>`'. (Headers '`Rinternals.h`' and '`Rinterface.h`' already did, and inclusion of system headers can still be circumvented by defining `NO_C_HEADERS`, including as from this version for those two headers.)
  The manual has long said that R headers should **not** be included within an `extern "C"` block, and almost all the packages affected by this change were doing so.
- Including header '`S.h`' from C++ code would fail on some platforms, and so gives a compilation error on all.
- The deprecated header '`Rdefines.h`' is now compatible with defining `R_NO_REMAP`.

- The connections interface now includes a function `R_GetConnection()` which allows packages implementing connections to convert R `connection` objects to `Rconnection` handles. Code which previously used the low-level R-internal `getConnection()` entry point should switch.

BUG FIXES:

- C-level `asChar(x)` is fixed for when `x` is not a vector, and it returns `"TRUE"`/`"FALSE"` instead of `"T"`/`"F"` for logical vectors.
- The first arguments of `.colSums()` etc (with an initial dot) are now named `x` rather than `X` (matching `colSums()`): thus error messages are corrected.
- A `coef()` method for class `"maov"` has been added to allow `vcov()` to work with multivariate results. (PR#16380)
- `method = "libcurl"` connections signal errors rather than retrieving HTTP error pages (where the ISP reports the error).
- `xpdrows.data.frame()` was not checking for unique row names; in particular, this affected assignment to non-existing rows *via* numerical indexing. (PR#16570)
- `tail.matrix()` did not work for zero rows matrices, and could produce row "labels" such as `"[1e+05,]"`.
- Data frames with a column named `"stringsAsFactors"` now format and print correctly. (PR#16580)
- `cor()` is now guaranteed to return a value with absolute value less than or equal to 1. (PR#16638)
- Array subsetting now keeps `names(dim(.))`.
- Blocking socket connection selection recovers more gracefully on signal interrupts.
- The `data.frame` method of `rbind()` construction `row.names` works better in borderline integer cases, but may change the names assigned. (PR#16666)
- (X11 only) `getGraphicsEvent()` miscoded buttons and missed mouse motion events. (PR#16700)
- `methods(round)` now also lists `round.POSIXt`.
- `tar()` now works with the default `files = NULL`. (PR#16716)
- Jumps to outer contexts, for example in error recovery, now make intermediate jumps to contexts where `on.exit()` actions are established instead of trying to run all `on.exit()` actions before jumping to the final target. This unwinds the stack gradually, releases resources held on the stack, and significantly reduces the chance of a segfault when running out of C stack space. Error handlers established using `withCallingHandlers()` and `options("error")` specifications are ignored when handling a C stack overflow error as attempting one of these would trigger a cascade of C stack overflow errors. (These changes resolve PR#16753.)
- The spacing could be wrong when printing a complex array. (Report and patch by Lukas Stadler.)
- `pretty(d,n,min.n,*)` for date-time objects `d` works again in border cases with large `min.n`, returns a `labels` attribute also for small-range dates and in such cases its returned length is closer to the desired `n`. (PR#16761) Additionally, it finally does cover the range of `d`, as it always claimed.
- `tsp(x) <-NULL` did not handle correctly objects inheriting from both `"ts"` and `"mts"`. (PR#16769)
- `install.packages()` could give false errors when `options("pkgType")` was `"binary"`. (Reported by Jose Claudio Faria.)
- A bug fix in R 3.0.2 fixed problems with `locator()` in X11, but introduced problems in Windows. Now both should be fixed. (PR#15700)

- `download.file()` with `method = "wininet"` incorrectly warned of download file length difference when reported length was unknown. (PR#16805)
- `diag(NULL,1)` crashed because of missed type checking. (PR#16853)



CHANGES IN R 3.2.5

BUG FIXES:

- `format.POSIXlt()` behaved incorrectly in R 3.2.4. E.g. the output of `format(as.POSIXlt(paste0(1940:2000,"-01-01"),tz = "CET"),usetz = TRUE)` ended in two `"CEST"` time formats.



CHANGES IN R 3.2.4

NEW FEATURES:

- `install.packages()` and related functions now give a more informative warning when an attempt is made to install a base package.
- `summary(x)` now prints with less rounding when `x` contains infinite values. (Request of PR#16620.)
- `provideDimnames()` gets an optional `unique` argument.
- `shQuote()` gains `type = "cmd2"` for quoting in `cmd.exe` in Windows. (Response to PR#16636.)
- The `data.frame` method of `rbind()` gains an optional argument `stringsAsFactors` (instead of only depending on `getOption("stringsAsFactors")`).
- `smooth(x,*)` now also works for long vectors.
- `tools::texi2dvi()` has a workaround for problems with the `texi2dvi` script supplied by **texinfo 6.1**.
  It extracts more error messages from the LaTeX logs when in emulation mode.

UTILITIES:

- `R CMD check` will leave a log file '`build_vignettes.log`' from the re-building of vignettes in the '`.Rcheck`' directory if there is a problem, and always if environment variable `_R_CHECK_ALWAYS_LOG_VIGNETTE_OUTPUT_` is set to a true value.

DEPRECATED AND DEFUNCT:

- Use of '`SUPPORT_OPENMP`' from header '`Rconfig.h`' is deprecated in favour of the standard OpenMP define '`_OPENMP`'.
  (This has been the recommendation in the manual for a while now.)
- The `make` macro `AWK` which is long unused by R itself but recorded in file '`etc/Makeconf`' is deprecated and will be removed in R 3.3.0.
- The C header file '`S.h`' is no longer documented: its use should be replaced by '`R.h`'.

BUG FIXES:

- `kmeans(x,centers = <1-row>)` now works. (PR#16623)
- `Vectorize()` now checks for clashes in argument names. (PR#16577)
- `file.copy(overwrite = FALSE)` would signal a successful copy when none had taken place. (PR#16576)
- `ngettext()` now uses the same default domain as `gettext()`. (PR#14605)

- `array(..,dimnames = *)` now warns about non-`list` dimnames and, from R 3.3.0, will signal the same error for invalid dimnames as `matrix()` has always done.
- `addmargins()` now adds dimnames for the extended margins in all cases, as always documented.
- `heatmap()` evaluated its `add.expr` argument in the wrong environment. (PR#16583)
- `require()` etc now give the correct entry of `lib.loc` in the warning about an old version of a package masking a newer required one.
- The internal deparser did not add parentheses when necessary, e.g. before `[]` or `[[]]`. (Reported by Lukas Stadler; additional fixes included as well).
- `as.data.frame.vector(*,row.names=*)` no longer produces 'corrupted' data frames from row names of incorrect length, but rather warns about them. This will become an error.
- `url` connections with `method = "libcurl"` are destroyed properly. (PR#16681)
- `withCallingHandler()` now (again) handles warnings even during S4 generic's argument evaluation. (PR#16111)
- `deparse(...,control = "quoteExpressions")` incorrectly quoted empty expressions. (PR#16686)
- `format()`ting datetime objects (`"POSIX[cl]?t"`) could segfault or recycle wrongly. (PR#16685)
- `plot.ts(<matrix>,las = 1)` now does use `las`.
- `saveRDS(*,compress = "gzip")` now works as documented. (PR#16653)
- (Windows only) The `Rgui` front end did not always initialize the console properly, and could cause R to crash. (PR#16698)
- `dummy.coef.lm()` now works in more cases, thanks to a proposal by Werner Stahel (PR#16665). In addition, it now works for multivariate linear models (`"mlm"`, `manova`) thanks to a proposal by Daniel Wollschlaeger.
- The `as.hclust()` method for `"dendrogram"`s failed often when there were ties in the heights.
- `reorder()` and `midcache.dendrogram()` now are non-recursive and hence applicable to somewhat deeply nested dendrograms, thanks to a proposal by Suharto Anggono in PR#16424.
- `cor.test()` now calculates very small p values more accurately (affecting the result only in extreme not statistically relevant cases). (PR#16704)
- `smooth(*,do.ends=TRUE)` did not always work correctly in R versions between 3.0.0 and 3.2.3.
- `pretty(D)` for date-time objects `D` now also works well if `range(D)` is (much) smaller than a second. In the case of only one unique value in `D`, the pretty range now is more symmetric around that value than previously.
  Similarly, `pretty(dt)` no longer returns a length 5 vector with duplicated entries for `Date` objects `dt` which span only a few days.
- The figures in help pages such as `?points` were accidentally damaged, and did not appear in R 3.2.3. (PR#16708)
- `available.packages()` sometimes deleted the wrong file when cleaning up temporary files. (PR#16712)
- The `X11()` device sometimes froze on Red Hat Enterprise Linux 6. It now waits for `MapNotify` events instead of `Expose` events, thanks to Siteshwar Vashisht. (PR#16497)
- `[dpqr]nbinom(*,size=Inf,mu=.)` now works as limit case, for 'dpq' as the Poisson. (PR#16727)
  `pnbinom()` no longer loops infinitely in border cases.

- `approxfun(*,method="constant")` and hence `ecdf()` which calls the former now correctly "predict" `NaN` values as `NaN`.
- `summary.data.frame()` now displays `NA`s in `Date` columns in all cases. (PR#16709)



CHANGES IN R 3.2.3

NEW FEATURES:

- Some recently-added Windows time zone names have been added to the conversion table used to convert these to Olson names. (Including those relating to changes for Russia in Oct 2014, as in PR#16503.)
- (Windows) Compatibility information has been added to the manifests for '`Rgui.exe`', '`Rterm.exe`' and '`Rscript.exe`'. This should allow `win.version()` and `Sys.info()` to report the actual Windows version up to Windows 10.
- Windows `"wininet"` FTP first tries EPSV / PASV mode rather than only using active mode (reported by Dan Tenenbaum).
- `which.min(x)` and `which.max(x)` may be much faster for logical and integer `x` and now also work for long vectors.
- The 'emulation' part of `tools::texi2dvi()` has been somewhat enhanced, including supporting `quiet = TRUE`. It can be selected by `texi2dvi = "emulation"`. (Windows) MiKTeX removed its `texi2dvi.exe` command in Sept 2015: `tools::texi2dvi()` tries `texify.exe` if it is not found.
- (Windows only) Shortcuts for printing and saving have been added to menus in `Rgui.exe`. (Request of PR#16572.)
- `loess(...,iterTrace=TRUE)` now provides diagnostics for robustness iterations, and the `print()` method for `summary(<loess>)` shows slightly more.
- The included version of PCRE has been updated to 8.38, a bug-fix release.
- `View()` now displays nested data frames in a more friendly way. (Request with patch in PR#15915.)

INSTALLATION and INCLUDED SOFTWARE:

- The included configuration code for `libintl` has been updated to that from `gettext` version 0.19.5.1 — this should only affect how an external library is detected (and the only known instance is under OpenBSD). (Wish of PR#16464.)
- `configure` has a new argument '`--disable-java`' to disable the checks for Java.
- The `configure` default for `MAIN_LDFLAGS` has been changed for the FreeBSD, NetBSD and Hurd OSes to one more likely to work with compilers other than `gcc` (FreeBSD 10 defaults to `clang`).
- `configure` now supports the OpenMP flags '`-fopenmp=libomp`' (clang) and '`-qopenmp`' (Intel C).
- Various macros can be set to override the default behaviour of `configure` when detecting OpenMP: see file '`config.site`'.
- Source installation on Windows has been modified to allow for MiKTeX installations without `texi2dvi.exe`. See file '`MkRules.dist`'.

BUG FIXES:

- `regexpr(pat,x,perl = TRUE)` with Python-style named capture did not work correctly when `x` contained `NA` strings. (PR#16484)
- The description of dataset `ToothGrowth` has been improved/corrected. (PR#15953)

- `model.tables(type = "means")` and hence `TukeyHSD()` now support `"aov"` fits without an intercept term. (PR#16437)
- `close()` now reports the status of a `pipe()` connection opened with an explicit `open` argument. (PR#16481)
- Coercing a list without names to a data frame is faster if the elements are very long. (PR#16467)
- (Unix-only) Under some rare circumstances piping the output from `Rscript` or `R -f` could result in attempting to close the input file twice, possibly crashing the process. (PR#16500)
- (Windows) `Sys.info()` was out of step with `win.version()` and did not report Windows 8.
- `topenv(baseenv())` returns `baseenv()` again as in R 3.1.0 and earlier. This also fixes `compilerJIT(3)` when used in '`.Rprofile`'.
- `detach()`ing the **methods** package keeps `.isMethodsDispatchOn()` true, as long as the methods namespace is not unloaded.
- Removed some spurious warnings from `configure` about the preprocessor not finding header files. (PR#15989)
- `rchisq(*,df=0,ncp=0)` now returns `0` instead of `NaN`, and `dchisq(*,df=0,ncp=*)` also no longer returns `NaN` in limit cases (where the limit is unique). (PR#16521)
- `pchisq(*,df=0,ncp > 0,log.p=TRUE)` no longer underflows (for ncp ¿ ˜60).
- `nchar(x,"w")` returned -1 for characters it did not know about (e.g. zero-width spaces): it now assumes 1. It now knows about most zero-width characters and a few more double-width characters.
- Help for `which.min()` is now more precise about behavior with logical arguments. (PR#16532)
- The print width of character strings marked as `"latin1"` or `"bytes"` was in some cases computed incorrectly.
- `abbreviate()` did not give names to the return value if `minlength` was zero, unlike when it was positive.
- (Windows only) `dir.create()` did not always warn when it failed to create a directory. (PR#16537)
- When operating in a non-UTF-8 multibyte locale (e.g. an East Asian locale on Windows), `grep()` and related functions did not handle UTF-8 strings properly. (PR#16264)
- `read.dcf()` sometimes misread lines longer than 8191 characters. (Reported by Hervé Pagès with a patch.)
- `within(df,..)` no longer drops columns whose name start with a `"."`.
- The built-in `HTTP` server converted entire `Content-Type` to lowercase including parameters which can cause issues for multi-part form boundaries (PR#16541).
- Modifying slots of S4 objects could fail when the **methods** package was not attached. (PR#16545)
- `splineDesign(*,outer.ok=TRUE)` (**splines**) is better now (PR#16549), and `interpSpline()` now allows `sparse=TRUE` for speedup with non-small sizes.
- If the expression in the traceback was too long, `traceback()` did not report the source line number. (Patch by Kirill Müller.)
- The browser did not truncate the display of the function when exiting with `options("deparse.max.lines")` set. (PR#16581)
- When `bs(*,Boundary.knots=)` had boundary knots inside the data range, extrapolation was somewhat off. (Patch by Trevor Hastie.)

- `var()` and hence `sd()` warn about `factor` arguments which are deprecated now. (PR#16564)
- `loess(*,weights = *)` stored wrong weights and hence gave slightly wrong predictions for `newdata`. (PR#16587)
- `aperm(a,*)` now preserves `names(dim(a))`.
- `poly(x,..)` now works when either `raw=TRUE` or `coef` is specified. (PR#16597)
- `data(package=*)` is more careful in determining the path.
- `prettyNum(*,decimal.mark,big.mark)`: fixed bug introduced when fixing PR#16411.



CHANGES IN R 3.2.2

SIGNIFICANT USER-VISIBLE CHANGES:

- It is now easier to use secure downloads from '`https://`' URLs on builds which support them: no longer do non-default options need to be selected to do so. In particular, packages can be installed from repositories which offer '`https://`' URLs, and those listed by `setRepositories()` now do so (for some of their mirrors).
  Support for '`https://`' URLs is available on Windows, and on other platforms if support for `libcurl` was compiled in and if that supports the `https` protocol (system installations can be expected to do). So '`https://`' support can be expected except on rather old OSes (an example being OS X 'Snow Leopard', where a non-system version of `libcurl` can be used).
  (Windows only) The default method for accessing URLs *via* `download.file()` and `url()` has been changed to be `"wininet"` using Windows API calls. This changes the way proxies need to be set and security settings made: there have been some reports of '`ftp:`' sites being inaccessible under the new default method (but the previous methods remain available).

NEW FEATURES:

- `cmdscale()` gets new option `list.` for increased flexibility when a list should be returned.
- `configure` now supports `texinfo` version 6.0, which (unlike the change from 4.x to 5.0) is a minor update. (Wish of PR#16456.)
- (Non-Windows only) `download.file()` with default `method = "auto"` now chooses `"libcurl"` if that is available and a '`https://`' or '`ftps://`' URL is used.
- (Windows only) `setInternet2(TRUE)` is now the default. The command-line option `--internet2` and environment variable `R_WIN_INTERNET2` are now ignored.
  Thus by default the `"internal"` method for `download.file()` and `url()` uses the `"wininet"` method: to revert to the previous default use `setInternet2(FALSE)`.
  This means that '`https://`' URLs can be read by default by `download.file()` (they have been readable by `file()` and `url()` since R 3.2.0).
  There are implications for how proxies need to be set (see `?download.file`).
- `chooseCRANmirror()` and `chooseBioCmirror()` now offer HTTPS mirrors in preference to HTTP mirrors. This changes the interpretation of their `ind` arguments: see their help pages.
- `capture.output()` gets optional arguments `type` and `split` to pass to `sink()`, and hence can be used to capture messages.

C-LEVEL FACILITIES:

- Header 'Rconfig.h' now defines HAVE_ALLOCA_H if the platform has the 'alloca.h' header (it is needed to define alloca on Solaris and AIX, at least: see 'Writing R Extensions' for how to use it).

INSTALLATION and INCLUDED SOFTWARE:

- The libtool script generated by configure has been modified to support FreeBSD ¿= 10 (PR#16410).

BUG FIXES:

- The HTML help page links to demo code failed due to a change in R 3.2.0. (PR#16432)
- If the na.action argument was used in model.frame(), the original data could be modified. (PR#16436)
- getGraphicsEvent() could cause a crash if a graphics window was closed while it was in use. (PR#16438)
- matrix(x,nr,nc,byrow = TRUE) failed if x was an object of type "expression".
- strptime() could overflow the allocated storage on the C stack when the time-zone had a non-standard format much longer than the standard formats. (Part of PR#16328.)
- options(OutDec = s) now signals a warning (which will become an error in the future) when s is not a string with exactly one character, as that has been a documented requirement.
- prettyNum() gains a new option input.d.mark which together with other changes, e.g., the default for decimal.mark, fixes some format()ting variants with non-default getOption("OutDec") such as in PR#16411.
- download.packages() failed for type equal to either "both" or "binary". (Reported by Dan Tenenbaum.)
- The dendrogram method of labels() is much more efficient for large dendrograms, now using rapply(). (Comment #15 of PR#15215)
- The "port" algorithm of nls() could give spurious errors. (Reported by Radford Neal.)
- Reference classes that inherited from reference classes in another package could invalidate methods of the inherited class. Fixing this requires adding the ability for methods to be "external", with the object supplied explicitly as the first argument, named .self. See "Inter-Package Superclasses" in the documentation.
- readBin() could fail on the SPARC architecture due to alignment issues. (Reported by Radford Neal.)
- qt(*,df=Inf,ncp=.) now uses the natural qnorm() limit instead of returning NaN. (PR#16475)
- Auto-printing of S3 and S4 values now searches for print() in the base namespace and show() in the **methods** namespace instead of searching the global environment.
- polym() gains a coefs = NULL argument and returns class "poly" just like poly() which gets a new simple=FALSE option. They now lead to correct predict()ions, e.g., on subsets of the original data. (PR#16239)
- rhyper(nn,<large>) now works correctly. (PR#16489)
- ttkimage() did not (and could not) work so was removed. Ditto for tkimage.cget() and tkimage.configure(). Added two Ttk widgets and missing subcommands for Tk's image command: ttkscale(), ttkspinbox(), tkimage.delete(), tkimage.height(), tkimage.inuse(), tkimage.type(), tkimage.types(), tkimage.width(). (PR#15372, PR#16450)
- getClass("foo") now also returns a class definition when it is found in the cache more than once.



CHANGES IN R 3.2.1

NEW FEATURES:

- `utf8ToInt()` now checks that its input is valid UTF-8 and returns `NA` if it is not.
- `install.packages()` now allows `type = "both"` with `repos = NULL` if it can infer the type of file.
- `nchar(x,*)` and `nzchar(x)` gain a new argument `keepNA` which governs how the result for `NA`s in `x` is determined. For `nzchar()` in general and `nchar()` in the R 3.2.x series, the default remains `FALSE` which is fully back compatible. From R 3.3.0, `nchar()`'s default will change to `keepNA = NA` and you are advised to consider this for code portability.
- `news()` more flexibly extracts dates from package '`NEWS.Rd`' files.
- `lengths(x)` now also works (trivially) for atomic `x` and hence can be used more generally as an efficient replacement of `sapply(x,length)` and similar.
- The included version of PCRE has been updated to 8.37, a bug-fix release.
- `diag()` no longer duplicates a matrix when extracting its diagonal.
- `as.character.srcref()` gains an argument to allow characters corresponding to a range of source references to be extracted.

BUG FIXES:

- `acf()` and `ccf()` now guarantee values strictly in $[-1, 1]$ (instead of sometimes very slightly outside). PR#15832.
- `as.integer("111111111111")` now gives NA (with a warning) as it does for the corresponding numeric or negative number coercions. Further, `as.integer(M + 0.1)` now gives `M` (instead of NA) when M is the maximal representable integer.
- On some platforms `nchar(x,"c")` and `nchar(x,"w")` would return values (possibly `NA`) for inputs which were declared to be UTF-8 but were not, or for invalid strings without a marked encoding in a multi-byte locale, rather than give an error. Additional checks have been added to mitigate this.
- `apply(a,M,function(u) c(X = .,Y = .))` again has dimnames containing "X" and "Y" (as in R ¡ 3.2.0).
- (Windows only) In some cases, the `--clean` option to `R CMD INSTALL` could fail. (PR#16178)
- (Windows only) `choose.files()` would occasionally include characters from the result of an earlier call in the result of a later one. (PR#16270)
- A change in `RSiteSearch()` in R 3.2.0 caused it to submit invalid URLs. (PR#16329)
- `Rscript` and command line `R` silently ignored incomplete statements at the end of a script; now they are reported as parse errors. (PR#16350)
- Parse data for very long strings was not stored. (PR#16354)
- `plotNode()`, the workhorse of the `plot` method for `"dendrogram"`s is no longer recursive, thanks to Suharto Anggono, and hence also works for deeply nested dendrograms. (PR#15215)
- The parser could overflow internally when given numbers in scientific format with extremely large exponents. (PR#16358)
- If the CRAN mirror was not set, `install.packages(type = "both")` and related functions could repeatedly query the user for it. (Part of PR#16362)
- The low-level functions `.rowSums()` etc. did not check the length of their argument, so could segfault. (PR#16367)

- The `quietly` argument of `library()` is now correctly propagated from `.getRequiredPackages2()`.
- Under some circumstances using the internal PCRE when building R from source would cause external libs such as `-llzma` to be omitted from the main link.
- The .Primitive default methods of the logic operators, i.e., `!`, `&` and `|`, now give correct error messages when appropriate, e.g., for `` `&`(TRUE) `` or `` `!`() ``. (PR#16385)
- `cummax(x)` now correctly propagates `NA`s also when `x` is of type `integer` and begins with an `NA`.
- `summaryRprof()` could fail when the profile contained only two records. (PR#16395)
- HTML vignettes opened using `vignette()` did not support links into the rest of the HTML help system. (Links worked properly when the vignette was opened using `browseVignettes()` or from within the help system.)
- `arima(*,xreg = .)` (for $d \geq 1$) computes estimated variances based on a the number of effective observations as in R version 3.0.1 and earlier. (PR#16278)
- `slotNames(.)` is now correct for `"signature"` objects (mostly used internally in **methods**).
- On some systems, the first string comparison after a locale change would result in `NA`.



CHANGES IN R 3.2.0

NEW FEATURES:

- `anyNA()` gains a `recursive` argument.
- When `x` is missing and `names` is not false (including the default value), `Sys.getenv(x,names)` returns an object of class `"Dlist"` and hence prints tidily.
- (Windows.) `shell()` no longer consults the environment variable `SHELL`: too many systems have been encountered where it was set incorrectly (usually to a path where software was compiled, not where it was installed). `R_SHELL`, the preferred way to select a non-default shell, can be used instead.
- Some unusual arguments to `embedFonts()` can now be specified as character vectors, and the defaults have been changed accordingly.
- Functions in the `Summary` group duplicate less. (PR#15798)
- (Unix-alikes.) `system(cmd,input = )` now uses 'shell-execution-environment' redirection, which will be more natural if `cmd` is not a single command (but requires a POSIX-compliant shell). (Wish of PR#15508)
- `read.fwf()` and `read.DIF()` gain a `fileEncoding` argument, for convenience.
- Graphics devices can add attributes to their description in `.Device` and `.Devices`. Several of those included with R use a `"filepath"` attribute.
- `pmatch()` uses hashing in more cases and so is faster at the expense of using more memory. (PR#15697)
- `pairs()` gains new arguments to select sets of variables to be plotted against each other.
- `file.info(,extra_cols = FALSE)` allows a minimal set of columns to be computed on Unix-alikes: on some systems without properly-configured caching this can be significantly faster with large file lists.
- New function `dir.exists()` in package **base** to test efficiently whether one or more paths exist and are directories.
- `dput()` and friends gain new controls '`hexNumeric`' and '`digits17`' which output double and complex quantities as, respectively, binary fractions (exactly, see `sprintf("%a")`) and as decimals with up to 17 significant digits.

- `save()`, `saveRDS()` and `serialize()` now support `ascii = NA` which writes ASCII files using `sprintf("%a")` for double/complex quantities. This is read-compatible with `ascii = TRUE` but avoids binary-¿decimal-¿binary conversions with potential loss of precision. Unfortunately the Windows C runtime's lack of C99 compliance means that the format cannot be read correctly there in R before 3.1.2.
- The default for `formatC(decimal.mark =)` has been changed to be `getOption("OutDec")`; this makes it more consistent with `format()` and suitable for use in print methods, e.g. those for classes `"density"`, `"ecdf"`, `"stepfun"` and `"summary.lm"`.
  `getOption("OutDec")` is now consulted by the print method for class `"kmeans"`, by `cut()`, `dendrogram()`, `plot.ts()` and `quantile()` when constructing labels and for the report from `legend(trace = TRUE)`.
  (In part, wish of PR#15819.)
- `printNum()` and hence `format()` and `formatC()` give a warning if `big.mark` and `decimal.mark` are set to the same value (period and comma are not uncommonly used for each, and this is a check that conventions have not got mixed).
- `merge()` can create a result which uses long vectors on 64-bit platforms.
- `dget()` gains a new argument `keep.source` which defaults to `FALSE` for speed (`dput()` and `dget()` are most often used for data objects where this can make `dget()` many times faster).
- Packages may now use a file of common macro definitions in their help files, and may import definitions from other packages.
- A number of macros have been added in the new '`share/Rd`' directory for use in package overview help pages, and `promptPackage()` now makes use of them.
- `tools::parse_Rd()` gains a new `permissive` argument which converts unrecognized macros into text. This is used by `utils:::format.bibentry` to allow LaTeX markup to be ignored.
- `options(OutDec =)` can now specify a multi-byte character, e.g., `options(OutDec = "\u00b7")` in a UTF-8 locale.
- `is.recursive(x)` is no longer true when `x` is an external pointer, a weak reference or byte code; the first enables `all.equal(x,x)` when `x <-getClass(.)`.
- `ls()` (aka `objects()`) and `as.list.environment()` gain a new argument `sorted`.
- The `"source"` attribute (which has not been added to functions by R since before R version 2.14.0) is no longer treated as special.
- Function `returnValue()` has been added to give `on.exit()` code access to a function's return value for debugging purposes.
- `crossprod(x,y)` allows more matrix coercions when `x` or `y` are vectors, now equalling `t(x) %*% y` in these cases (also reported by Radford Neal). Similarly, `tcrossprod(x,y)` and `%*%` work in more cases with vector arguments.
- Utility function `dynGet()` useful for detecting cycles, aka infinite recursions.
- The byte-code compiler and interpreter include new instructions that allow many scalar subsetting and assignment and scalar arithmetic operations to be handled more efficiently. This can result in significant performance improvements in scalar numerical code.
- `apply(m,2,identity)` is now the same as the matrix `m` when it has *named* row names.
- A new function `debuggingState()` has been added, allowing to temporarily turn off debugging.
- `example()` gets a new optional argument `run.donttest` and `tools::Rd2ex()` a corresponding `commentDonttest`, with a default such that `example(..)` in help examples will run `\donttest` code only if used interactively (a change in behaviour).

- `rbind.data.frame()` gains an optional argument `make.row.names`, for potential speedup.
- New function `extSoftVersion()` to report on the versions of third-party software in use in this session. Currently reports versions of `zlib`, `bzlib`, the `liblzma` from `xz`, PCRE, ICU, TRE and the `iconv` implementation.
  A similar function `grSoftVersion()` in package **grDevices** reports on third-party graphics software.
  Function `tcltk::tclVersion()` reports the Tcl/Tk version.
- Calling `callGeneric()` without arguments now works with primitive generics to some extent.
- `vapply(x,FUN,FUN.VALUE)` is more efficient notably for large `length(FUN.VALUE)`; as extension of PR#16061.
- `as.table()` now allows tables with one or more dimensions of length 0 (such as `as.table(integer())`).
- `names(x) <-NULL` now clears the names of call and `...` objects.
- `library()` will report a warning when an insufficient dependency version is masking a sufficient one later on the library search path.
- A new `plot()` method for class `"raster"` has been added.
- New `check_packages_in_dir_changes()` function in package **tools** for conveniently analyzing how changing sources impacts the check results of their reverse dependencies.
- Speed-up from Peter Haverty for `ls()` and `methods:::.requirePackage()` speeding up package loading. (PR#16133)
- New `get0()` function, combining `exists()` and `get()` in one call, for efficiency.
- `match.call()` gains an `envir` argument for specifying the environment from which to retrieve the `...` in the call, if any; this environment was wrong (or at least undesirable) when the `definition` argument was a function.
- `topenv()` has been made `.Internal()` for speedup, based on Peter Haverty's proposal in PR#16140.
- `getOption()` no longer calls `options()` in the main case.
- Optional use of `libcurl` (version 7.28.0 from Oct 2012 or later) for Internet access:
  - `capabilities("libcurl")` reports if this is available.
  - `libcurlVersion()` reports the version in use, and other details of the `"libcurl"` build including which URL schemes it supports.
  - `curlGetHeaders()` retrieves the headers for '`http://`', '`https://`', '`ftp://`' and '`ftps://`' URLs: analysis of these headers can provide insights into the 'existence' of a URL (it might for example be permanently redirected) and is so used in `R CMD check --as-cran`.
  - `download.file()` has a new optional method `"libcurl"` which will handle more URL schemes, follow redirections, and allows simultaneous downloads of multiple URLs.
  - `url()` has a new method `"libcurl"` which handles more URL schemes and follows redirections. The default method is controlled by a new option `url.method`, which applies also to the opening of URLs *via* `file()` (which happens implicitly in functions such as `read.table`.)
  - When `file()` or `url()` is invoked with a `https://` or `ftps://` URL which the current method cannot handle, it switches to a suitable method if one is available.
- (Windows.) The DLLs '`internet.dll`' and '`internet2.dll`' have been merged. In this version it is safe to switch (repeatedly) between the internal and Windows internet functions within an R session.

The Windows internet functions are still selected by flag '`--internet2`' or `setInternet2()`. This can be overridden for an `url()` connection *via* its new `method` argument.
`download.file()` has new method `"wininet"`, selected as the default by '`--internet2`' or `setInternet2()`.

- `parent.env<-` can no longer modify the parent of a locked namespace or namespace imports environment. Contributed by Karl Millar.
- New function `isNamespaceLoaded()` for readability and speed.
- `names(env)` now returns all the object names of an `environment env`, equivalently to `ls(env,all.names = TRUE,sorted = FALSE)` and also to the names of the corresponding list, `names(as.list(env,all.names = TRUE))`. Note that although `names()` returns a character vector, the names have no particular ordering.
- The memory manager now grows the heap more aggressively. This reduces the number of garbage collections, in particular while data or code are loaded, at the expense of slightly increasing the memory footprint.
- New function `trimws()` for removing leading/trailing whitespace.
- `cbind()` and `rbind()` now consider S4 inheritance during S3 dispatch and also obey `deparse.level`.
- `cbind()` and `rbind()` will delegate recursively to `methods::cbind2` (`methods::rbind2`) when at least one argument is an S4 object and S3 dispatch fails (due to ambiguity).
- (Windows.) `download.file(quiet = FALSE)` now uses text rather than Windows progress bars in non-interactive use.
- New function `hsearch_db()` in package **utils** for building and retrieving the help search database used by `help.search()`, along with functions for inspecting the concepts and keywords in the help search database.
- New function `.getNamespaceInfo()`, a no-check version of `getNamespaceInfo()` mostly for internal speedups.
- The help search system now takes '`\keyword`' entries in Rd files which are not standard keywords (as given in '`KEYWORDS`' in the R documentation directory) as concepts. For standard keyword entries the corresponding descriptions are additionally taken as concepts.
- New `lengths()` function for getting the lengths of all elements in a list.
- New function `toTitleCase()` in package **tools**, tailored to package titles.
- The matrix methods of `cbind()` and `rbind()` allow matrices as inputs which have 2^{31} or more elements. (For `cbind()`, wish of PR#16198.)
- The default method of `image()` has an explicit check for a numeric or logical matrix (which was always required).
- `URLencode()` will not by default encode further URLs which appear to be already encoded.
- `BIC(mod)` and `BIC(mod,mod2)` now give non-NA numbers for `arima()` fitted models, as `nobs(mod)` now gives the number of "used" observations for such models. This fixes PR#16198, quite differently than proposed there.
- The `print()` methods for `"htest"`, `"pairwise.htest"` and `"power.htest"` objects now have a `digits` argument defaulting to (a function of) `getOption("digits")`, and influencing all printed numbers coherently. Unavoidably, this changes the display of such test results in some cases.
- Code completion for namespaces now recognizes all loaded namespaces, rather than only the ones that are also attached.

- The code completion mechanism can now be replaced by a user-specified completer function, for (temporary) situations where the usual code completion is inappropriate.
- `unzip()` will now warn if it is able to detect truncation when unpacking a file of 4GB or more (related to PR#16243).
- `methods()` reports S4 in addition to S3 methods; output is simplified when the `class` argument is used. `.S3methods()` and `methods::.S4methods()` report S3 and S4 methods separately.
- Higher order functions such as the `apply` functions and `Reduce()` now force arguments to the functions they apply in order to eliminate undesirable interactions between lazy evaluation and variable capture in closures. This resolves PR#16093.

INSTALLATION and INCLUDED SOFTWARE:

- The `\donttest` sections of R's help files can be tested by `make check TEST_DONTTEST=TRUE` .
- It is possible to request the use of system `valgrind` headers *via* `configure` option '`--with-system-valgrind-headers`': note the possible future incompatibility of such headers discussed in the 'R Installation and Administration' manual. (Wish of PR#16068.)
- The included version of `liblzma` has been updated to `xz-utils` 5.0.7 (minor bug fixes from 5.0.5).
- `configure` options '`--with-system-zlib`', '`--with-system-bzlib`' and '`--with-system-pcre`' are now the default. For the time being there is fallback to the versions included in the R sources if no system versions are found or (unlikely) if they are too old.
  Linux users should check that the `-devel` or `-dev` versions of packages **zlib**, **bzip2**/**libbz2** and **pcre** as well as **xz-devel**/**liblzma-dev** (or similar names) are installed.
- `configure` by default looks for the `texi2any` script from **texinfo** 5.1 or later, rather than the `makeinfo` program. (`makeinfo` is a link to the Perl script `texi2any` in **texinfo** 5.x.)
- `R CMD INSTALL` gains an option '`--built-timestamp=STAMP`' allowing 100% reproducible package building, thanks to Dirk Eddelbuettel.

UTILITIES:

- There is support for testing the `\dontrun` and `\donttest` parts of examples in packages.
  `tools::testInstalledPackage()` accepts new arguments `commentDontrun = FALSE` and `commentDonttest = FALSE`.
  `R CMD check` gains options '`--run-dontrun`' and '`--run-donttest`'.
- The HTML generated by `tools::Rd2HTML()` and `tools::toHTML()` methods is now 'XHTML 1.0 Strict'.
- The **compiler** package's utility function `setCompilerOptions()` now returns the old values invisibly. The initial optimization level can also be set with the environment variable `R_COMPILER_OPTIMIZE`.
- `R CMD build` adds a '`NeedsCompilation`' field if one is not already present in the '`DESCRIPTION`' file.
- `R CMD check` gains option '`--test-dir`' to specify an alternative set of tests to run.
- `R CMD check` will now by default continue with testing after many types of errors, and will output a summary count of errors at the end if any have occurred.
- `R CMD check` now checks that the '`Title`' and '`Description`' fields are correctly terminated.

- `R CMD check --as-cran` now:
  - checks a '`README.md`' file can be processed: this needs `pandoc` installed.
  - checks the existence and accessibility of URLs in the '`DESCRIPTION`', '`CITATION`', '`NEWS.Rd`' and '`README.md`' files and in the help files (provided the build has `libcurl` support).
  - reports non-ASCII characters in R source files when there is no package encoding declared in the '`DESCRIPTION`' file.
  - reports (apparent) S3 methods exported but not registered.
  - reports overwriting registered S3 methods from base/recommended packages. (Such methods are replaced in the affected package for the rest of the session, even if the replacing namespace is unloaded.)
  - reports if the `Title` field does not appear to be in title case (see 'Writing R Extensions': there may be false positives, but note that technical words should be single-quoted and will then be accepted).

  Most of these checks can also be selected by environment variables: see the 'R Internals' manual.

C-LEVEL FACILITIES:

- New C API utility `logspace_sum(logx[],n)`.
- Entry points `rbinom_mu`, `rnbinom_mu` and `rmultinom` are remapped (by default) to `Rf_rbinom_mu` etc. This requires packages using them to be re-installed.
- `.C(DUP = FALSE)` and `.Fortran(DUP = FALSE)` are now ignored, so arguments are duplicated if `DUP = TRUE` would do so. As their help has long said, `.Call()` is much preferred.
- New entry point `R_allocLD`, like `R_alloc` but guaranteed to have sufficient alignment for `long double` pointers.
- `isPairList()` now returns `TRUE` for DOTSXP.

WINDOWS BUILD CHANGES: A number of changes to the Windows build system are in development. The following are currently in place.

- Installation using external binary distributions of **zlib**, **bzip2**, **liblzma**, **pcre**, **libpng**, **jpeglib** and **libtiff** is now required, and the build instructions have been revised.
- A new `make` target `rsync-extsoft` has been added to obtain copies of the external libraries from CRAN.
- Building the manuals now requires `texi2any` from **texinfo** 5.1 or later. CRAN binary builds include the manuals, but by default builds from source will not, and they will be accessed from CRAN. See the comments in '`src/gnuwin32/MkRules.dist`' for how to specify the location of `texi2any`.
- (Windows) Changes have been made to support an experimental Windows toolchain based on GCC 4.9.2. The default toolchain continues to be based on GCC 4.6.3, as the new toolchain is not yet stable enough. A change to a new toolchain is expected during the R 3.2.x lifetime.

PACKAGE INSTALLATION:

- (Windows) The use of macro `ZLIB_LIBS` in file '`src/Makevars.win`' (which has not been documented for a long time) now requires an external '`libz.a`' to be available (it is part of the 'goodies' used to compile Windows binary packages). It would be simpler to use `-lz` instead.

- The default for option `pkgType` on platforms using binary packages is now `"both"`, so source packages will be tried if binary versions are not available or not up to date. There are options for what `install.packages(type = "both")` (possibly called *via* `update.packages()`) will do if compilation of a source package is desirable: see `?options` (under **utils**).
  If you intend not to accept updates as source packages, you should use `update.packages(type = "binary")`.

DEPRECATED AND DEFUNCT:

- `download.file(method = "lynx")` is defunct.
- Building R using the included versions of `zlib`, `bzip2`, `xz` and PCRE is deprecated: these are frozen (bar essential bug-fixes) and will be removed for R 3.3.0.
- The `configure` option '`--with-valgrind-instrumentation=3`' has been withdrawn, as it did not work with recent `valgrind` headers: it is now treated as level `2`.
- The `MethodsList` class in package **methods** had been deprecated in R 2.11.0 and is defunct now. Functions using it are defunct if they had been deprecated in R 2.11.0, and are deprecated now, otherwise.

BUG FIXES:

- Fixed two obscure bugs in pairlist subassignment, reported by Radford Neal as part of pqR issue 16.
- Fixes for bugs in handling empty arguments and argument matching by name in `log()`.
- `all.equal()` gains methods for `environment`s and `refClass`es.
- `[<-` and `[[<-` gain S4 `data.frame` methods to avoid corruption of S4 class information by the S3 methods.
- `callNextMethod()` should now work within a `.local` call when `...` is absent from `formals(.local)`.
- `dput(pairlist(x))` generates a call to the `pairlist` constructor instead of the `list` constructor.
- Fix `missing()` when arguments are propagated through `...`. (PR#15707)
- `eigen(m)` now defaults to `symmetric = TRUE` even when the dimnames are asymmetric if the matrix is otherwise symmetric. (PR#16151)
- Fix issues with forwarding `...` through `callGeneric()` and `callNextMethod()`. (PR#16141)
- `callGeneric()` now works after a `callNextMethod()`.
- Subclass information is kept consistent when replacing an ordinary S4 class with an "old class" *via* the `S4Class` argument to `setOldClass()`. Thus, for example, a `data.frame` is valid for a `list` argument in the signature, and a `factor` is valid for `vector` arguments.
- In `qbeta()` the inversion of `pbeta()` is much more sophisticated. This works better in corner cases some of which failed completely previously (PR#15755), or were using too many iterations.
- Auto-printing no longer duplicates objects when printing is dispatched to a method.
- `kmeans(x,k)` would fail when `nrow(x) >= 42949673`. (Comment 6 of PR#15364)
- 'Abbreviated' locale-specific day and month names could have been truncated in those rare locales where there are the same as the full names.
- An irrelevant warning message from updating subclass information was silenced (the namespace would not be writable in this case).



CHANGES IN R 3.1.3

NEW FEATURES:

- The internal method of `download.file()` can now handle files larger than 2GB on 32-bit builds which support such files (tested on 32-bit R running on 64-bit Windows).
- `kruskal.test()` warns on more types of suspicious input.
- The `as.dendrogram()` method for `"hclust"` objects gains a `check` argument protecting against memory explosion for invalid inputs.
- `capabilities()` has a new item `long.double` which indicates if the build uses a `long double` type which is longer than `double`.
- `nlm()` no longer modifies the callback argument in place (a new vector is allocated for each invocation, which mimics the implicit duplication that occurred in R ¡ 3.1.0); note that this is a change from the previously documented behavior. (PR#15958)
- `icuSetCollate()` now accepts `locale = "ASCII"` which uses the basic C function `strcmp` and so collates strings byte-by-byte in numerical order.
- `sessionInfo()` tries to report the OS version in use (not just that compiled under, and including details of Linux distributions).
- `model.frame()` (used by `lm()` and many other modelling functions) now warns when it drops contrasts from factors. (Wish of PR#16119)
- `install.packages()` and friends now accept the value `type = "binary"` as a synonym for the native binary type on the platform (if it has one).
- Single source or binary files can be supplied for `install.packages(type = "both")` and the appropriate type and `repos = NULL` will be inferred.
- New function `pcre_config()` to report on some of the configuration options of the version of PCRE in use. In particular, this reports if regular expressions using '`\p{xx}`' are supported.
- (Windows.) `download.file(cacheOK = FALSE)` is now supported when '`internet2.dll`' is used.
- `browseURL()` has been updated to work with Firefox 36.0 which has dropped support for the '`-remote`' interface.

INSTALLATION and INCLUDED SOFTWARE:

- The included version of PCRE has been updated to 8.36.
- `configure` accepts '`MAKEINFO=texi2any`' as another way to ensure **texinfo** 5.x is used when both 5.x and 4.x are installed.

UTILITIES:

- `R CMD check` now checks the packages used in `\donttest` sections of the examples are specified in the '`DESCRIPTION`' file. (These are needed to run the examples interactively.)
- `R CMD check` checks for the undeclared use of GNU extensions in Makefiles, and for Makefiles with a missing final linefeed.
  `R CMD build` will correct line endings in all Makefiles, not just those in the '`src`' directory.
- `R CMD check` notes uses of `library()` and `require()` in package code: see the section 'Suggested packages' of 'Writing R Extensions' for good practice.

DEPRECATED AND DEFUNCT:

- The `configure` option '`--with-valgrind-instrumentation=3`' is deprecated and will be removed in R 3.2.0.

BUG FIXES:

- (Windows.) `Rscript.exe` was missing a manifest specifying the modern style for common controls (e.g., the download progress bar).
- If a package had extra documentation files but no vignette, the HTML help system produced an empty index page.
- The parser now gives an error if a null character is included in a string using Unicode escapes. (PR#16046)
- `qr.Q()` failed on complex arguments due to pre-3.0(!) typo. (PR#16054)
- `abs()` failed with named arguments when the argument was complex. (PR#16047)
- `"noquote"` objects may now be used as columns in data frames. (PR#15997)
- Some values with extremely long names were printed incorrectly. (PR#15999)
- Extremely large exponents on zero expressed in scientific notation (e.g. `0.0e50000`) could give `NaN`. (PR#15976)
- `download.file()` reported downloaded sizes as 0KB if less than 1MB, only for R 3.1.2 and only on big-endian platforms.
- `prompt()` did not escape percent signs in the automatically generated usage section of help files.
- `drop.terms()` dropped some of the attributes of the object it was working with. (PR#16029)
- (Windows.) The command completion in `Rgui.exe` messed up the console. (PR#15791)
- (Windows.) The `choose.files()` command returned a blank string when the user asked for a single file but cancelled the request. (PR#16074)
- `Math2` S4 group generics failed to correctly dispatch `"structure"`- and `"nonStructure"`-derived classes.
- `loadNamespace()` imposed undocumented restrictions on the `versionCheck` parameter. (Reported by Geoff Lee.)
- Rare over-runs detected by AddressSanitizer in `substr()` and its replacement version have been avoided.
  Inter alia that fix gives the documented behaviour for `substr(x,1,2) <-""` (subsequently reported as PR#16214).
- Loading packages incorrectly defining an S4 generic followed by a function of the same name caused an erroneous cyclic namespace dependency error.
- Declared vignette encodings are now always passed to the vignette engine.
- Port Tomas Kalibera's fix from R-devel that restores the `loadMethod()` fast path, effectively doubling the speed of S4 dispatch.
- `power.t.test()` and `power.prop.test()` now make use of the `extendInt` option of `uniroot()` and hence work in more extreme cases. (PR#15792)
- If a package was updated and attached when its namespace was already loaded, it could end up with parts from one version and parts from the other. (PR#16120)
- `tools:::.Rdconv()` didn't accept `--encoding=` due to a typo. (PR#16121)
- Unix-alike builds without a suitable `makeinfo` were documented to link the missing HTML manuals to CRAN, but did not.
- `save(*,ascii=TRUE)` and `load()` now correctly deal with `NaN`'s. (PR#16137)
- `split.Date()` retains fractional representations while avoiding incomplete class propagation.

- '`R_ext/Lapack.h`' had not been updated for changes made by LAPACK to the argument lists of its (largely internal) functions `dlaed2` and `dlaed3`. (PR#16157)
- `RShowDoc("NEWS","txt")` had not been updated for the layout changes of R 3.1.0.
- The `xtfrm()` method for class `"Surv"` has been corrected and its description expanded.
- `mode(x) <-y` would incorrectly evaluate `x` before changing its mode. (PR#16215)
- `besselJ(1,2^64)` and `besselY(..)` now signal a warning, returning `NaN` instead of typically segfaulting. (Issue 3 of PR#15554)
- HTML conversion of '`\href`' markup in '`.Rd`' files did not remove the backslash from '`\%`' and so gave an invalid URL. In a related change, the '\' escape is now required in such URLs.



CHANGES IN R 3.1.2

NEW FEATURES:

- `embedFonts()` now defaults to `format = "ps2write"` for '`.ps`' and '`.eps`' files. This is available in Ghostscript 9.x (since 2010) whereas the previous default, `format = "pswrite"`, was removed in Ghostscript 9.10.
- For consistency with `[dpqr]norm()`, `[dp]lnorm(sdlog = 0)` model a point mass at `exp(mulog)` rather than return `NaN` (for an error).
- `capabilities()` now reports if ICU is compiled in for use for collation (it is only actually used if a suitable locale is set for collation, and never for a `C` locale).
- (OS X only.) Package **tcltk** checks when loaded if it is linked against the CRAN X11-based Tcl/Tk and if so that the Tcl/Tk component and the X11 libraries are installed. This allows more informative error messages to be given advising the installation of the missing component or of XQuartz.
  The `X11()` device and X11-based versions of the data editor and viewer (invoked by `edit()` and `View()` for data frames and matrices from command-line R) check that the X11 libraries are installed and if not advises installing XQuartz.
- `icuSetCollate()` allows `locale = "default"`, and `locale = "none"` to use OS services rather than ICU for collation.
  Environment variable `R_ICU_LOCALE` can be used to set the default ICU locale, in case the one derived from the OS locale is inappropriate (this is currently necessary on Windows).
- New function `icuGetCollate()` to report on the ICU collation locale in use (if any).
- `utils::URLencode()` was updated to use unreserved and reserved characters from RFC 3986 (`http://tools.ietf.org/html/rfc3986`) instead of RFC 1738.
- `unique(warnings())` and `c(warnings())` are now supported.
- The Bioconductor 'version' used by `setRepositories()` now defaults to `3.0`. (It can be set at runtime *via* environment variable `R_BIOC_VERSION`.)
- Omegahat is no longer listed as providing Windows binary packages, e.g. by `setRepositories()`. It has no binary packages available for R 3.1.x and those for earlier versions were 32-bit only.

INSTALLATION and INCLUDED SOFTWARE:

- The `configure` script reports on the more important capabilities/options which will not be compiled in.
  More types of external BLAS are recognized by name in that report.

- When building R as a shared library, the '`-L${R_HOME}/lib${R_ARCH}`' flag is placed earlier in the link commands used during installation and when packages are installed: this helps ensure that the current build has priority if an R shared library has already been installed by e.g. `install-libR` in a library mentioned in `LDFLAGS` (and not in 'your system's library directory' as documented). (Wish of PR#15790.)
- LaTeX package **upquote** is no longer required for R's use of **inconsolata**.
- (Windows only) If both 32- and 64-bit versions of R are installed, the '`bin/R.exe`' and '`bin/Rscript.exe`' executables now run 64-bit R. (To run 32-bit R, overwrite these files with copies of '`bin/i386/Rfe.exe`'.)

UTILITIES:

- Running `R CMD check` with `_R_CHECK_DEPENDS_ONLY_` true now makes the '`VignetteBuilder`' packages available even if they are listed in '`Suggests`', since they are needed to recognise and process non-Sweave vignettes.
- `R CMD check` now reports empty `importFrom` declarations in a '`NAMESPACE`' file, as these are common errors (writing `importFrom(`*Pkg*`)` where `import(`*Pkg*`)` was intended).
- `R CMD check` now by default checks code usage directly on the package namespace without loading and attaching the package and its suggests and enhances. For good practice with packages in the '`Suggests`' field, see §1.1.3.1 of 'Writing R Extensions'. For use of lazy-data objects in the package's own code, see `?data`.

BUG FIXES:

- `dmultinom()` did not handle non-finite probabilities correctly.
- `prettyNum(x,zero.print=*)` now also works when `x` contains `NA`s.
- A longstanding bug exhibited by `nlminb()` on Windows was traced to a compiler bug in gcc 4.6.3; a workaround has been put in place. (PR#15244 and PR#15914).
- Rendering of `\command` in HTML versions of help pages has been improved: this is particularly evident on the help page for `INSTALL`.
- `as.hexmode(x)` and `as.octmode(x)` now behave correctly for some numeric `x`, e.g., `c(NA,1)` or `c(1,pi)`.
- `drop1()` failed if the `scope` argument had no variables to drop. (PR#15935)
- `edit()` (and hence `fix()`) failed if an object had a non-character attribute named `"source"` (an attribute that had been used in R prior to version 2.14.0).
- `callGeneric()` could fail if the generic had `...` as a formal argument. (PR#15937).
- Forking in package **parallel** called C entry point `exit` in the child. This was unsafe (`_exit` should have been called), and could flush `stdin` of the main R process (seen most often on Solaris).
  As good practice, `stdout` is now flushed before forking a child.
- R objects such as `list(`a\b` = 1)` now print correctly.
- `getAnywhere("C_pbinom")` now returns correctly a single object (rather than unlisting it).
- The `confint()` method for `nls()` fits failed it these has specified parameter limits despite using an algorithm other than `"port"`. (PR#15960)
- Subclassing an S4 class failed if the class required arguments to the generator, through its `initialize()` method.
- `removeSource()` did not properly handle expressions containing arguments that were supplied as missing, e.g. `x[i,]`. (PR#15957)
- `as.environment(list())` now works, and `as.list()` of such an environment is now the same as `list()`. (PR#15926)

- Several **tcltk** functions failed when run in unusual environments. (PR#15970)
- `options(list())` now works (trivially). (PR#15979)
- `merge(<dendrogram>,..)` now works correctly for two 'independent' dendrograms (PR#15648), and still compatibly *via* `adjust = "auto"` e.g. for two branches of an existing dendrogram.
- The `plot` method for `"hclust"` objects gets an optional argument `check`; when that is true (the default) it checks more carefully for valid input.
- (Windows only) If a user chose to install 64 bit R but not 32 bit R, the '`bin/R`' and '`bin/Rscript`' executables failed to run. (PR#15981)
- Various possible buffer overruns have been prevented, and missed memory protection added. (PR#15990)
- `Rscript` no longer passes `--args` to `R` when there are no extra ("user") arguments.
- objects like `getClass("refClass")@prototype` now `print()` and `str()` without error.
- `identical()` now also looks at the S4 bit.
- `hist(x,breaks)` is more robust in adding a small fuzz to few breaks when some are very large. (PR#15988)
- `sub()` and `gsub()` did not handle regular expressions like `"\s{2,}"` properly if the text contained `NA` or non-ASCII elements in a UTF-8 locale. Part of this was due to a bug in the TRE library. (PR#16009)
- `RShowDoc("NEWS")` now displays the PDF version.
- Matrices and arrays with last dimension zero did not print at all or incompletely. (PR#16012)
- `plot.histogram()` and hence `hist()` now respect the `xaxs`, `yaxs` and `lab` graphics parameters. (PR#16021)
- `bw.SJ(x)` and other bw.*() no longer segfault when `x` contains non-finite values. (PR#16024)
- `R CMD Rd2pdf` unintentionally ignored its '`--os`' option.
- The internal method of `download.file()` was not reporting file sizes and progress correctly on files larger than 2GB (inherited from `libxml2`). This is corrected for 64-bit builds (32-bit platforms may not support such files, but where possible will be supported in future versions of R).
- Work around a bug in OS X Yosemite where key environment variables may be duplicated causing issues in subprocesses. The duplicates are now removed on R startup (*via* Rprofile). (PR#16042)
- Adjust X11 auto-launch detection in DISPLAY on OS X to recognize latest XQuartz.



CHANGES IN R 3.1.1

NEW FEATURES:

- When `attach()` reports conflicts, it does so compatibly with `library()` by using `message()`.
- `R CMD Sweave` no longer cleans any files by default, compatibly with versions of R prior to 3.1.0. There are new options '`--clean`', '`--clean=default`' and '`--clean=keepOuts`'.
- `tools::buildVignette()` and `tools::buildVignettes()` with `clean = FALSE` no longer remove any created files. `buildvignette()` gains a `keep` argument for more cleaning customization.

- The Bioconductor 'version' used by `setRepositories()` can now be set by environment variable `R_BIOC_VERSION` at runtime, not just when R is installed. (It has been stated that Bioconductor will switch from 'version' 2.14 to 'version' 3.0 during the lifetime of the R 3.1 series.)
- Error messages from bugs in embedded '`Sexpr`' code in Sweave documents now report the source location.
- `type.convert()`, `read.table()` and similar `read.*()` functions get a new `numerals` argument, specifying how numeric input is converted when its conversion to double precision loses accuracy. The default value, `"allow.loss"` allows accuracy loss, as in R versions before 3.1.0.
- For some compilers, integer addition could overflow without a warning. R's internal code for both integer addition and subtraction is more robust now. (PR#15774)
- The function determining the default number of knots for `smooth.spline()` is now exported, as `.nknots.smspl()`.
- `dbeta(,a,b)`, `pbeta()`, `qbeta()` and `rbeta()` are now defined also for $a = 0$, $b = 0$, or infinite a and b (where they typically returned `NaN` before).
- Many package authors report that the RStudio graphics device does not work correctly with their package's use of `dev.new()`. The new option `dev.new(noRStudioGD = TRUE)` replaces the RStudio override by the default device as selected by R itself, still respecting environment variables `R_INTERACTIVE_DEVICE` and `R_DEFAULT_DEVICE`.
- `readRDS()` now returns visibly.
- Modifying internal logical scalar constants now results in an error instead of a warning.
- `install.packages(repos = NULL)` now accepts '`http://`' or '`ftp://`' URLs of package archives as well as file paths, and will download as required. In most cases `repos = NULL` can be deduced from the extension of the URL.
- The warning when using partial matching with the `$` operator on data frames is now only given when `options("warnPartialMatchDollar")` is `TRUE`.
- Package help requests like `package?foo` now try the package `foo` whether loaded or not.
- General help requests now default to trying all loaded packages, not just those on the search path.
- Added a new function `promptImport()`, to generate a help page for a function that was imported from another package (and presumably re-exported, or help would not be needed).

INSTALLATION and INCLUDED SOFTWARE:

- `configure` option '`--with-internal-tzcode`' can now be used with variable `rsharedir`.
- The included version of PCRE has been updated to 8.35.
- There is a new target `make uninstall-libR` to remove an installed shared/static '`libR`'.
  `make install-libR` now works if a sub-architecture is used, although the user will need to specify `libdir` differently for different sub-architectures.
- There is more extensive advice on which LaTeX packages are required to install R or to make package manuals (as done by `R CMD check`) in the 'Writing R Extensions' manual.
- Compilers/linkers were handling the visibility control in '`src/extra/xz`' inconsistently (and apparently in some cases incorrectly), so it has been simplified. (PR#15327)

- (Windows) There is updated support for the use of ICU for collation: see the 'R Installation and Administration Manual'.

BUG FIXES:

- `dbinom(x,n)`, `pbinom()`, `dpois()`, etc, are slightly less restrictive in checking if `n` is integer-valued. (Wish of PR#15734.)
- `pchisq(x,df,ncp,log.p = TRUE)` is more accurate and no longer underflows for small `x` and `ncp < 80`, e.g, for `pchisq(1e-5,df = 100,ncp = 1,log = TRUE)`. (Based on PR#15635 and a suggestion by Roby Joehanes.)
- The `s` ("step into") command in the debugger would cause R to step into expressions evaluated there, not just into functions being debugged. (PR#15770)
- The C code used by `strptime()` rejected time-zone offsets of more than `+1200` (`+1245`, `+1300` and `+1400` can occur). (PR#15768)
- (Windows only.) `png(type = "cairo",antialias = "gray")` was not accepted. (PR#15760)
- Use of `save(...,envir=)` with named objects could fail. (PR#15758)
- `Sweave()` mis-parsed '`Sexpr`' expressions that contained backslashes. (PR#15779)
- The return value from `options(foo = NULL)` was not the previous value of the option. (PR#15781)
- `enc2utf8()` and `enc2native()` did not always mark the encoding of the return values when it was known.
- `dnbinom(x,size = <large>,mu,log = TRUE)` no longer underflows to -Inf for large `mu`, thanks to a suggestion from Alessandro Mammana (MPI MolGen, Berlin).
- `pbeta(x,a,b,log = TRUE)` no longer behaves discontinuously (in a small x-region) because of denormalized numbers. Also, `pbeta(1-1e-12,1e30,1.001,log=TRUE)` now terminates "in real time".
- The `"CRAN"` filter (see `available.packages()`) no longer removes duplicates other than of packages on CRAN, and does not fail if there is no CRAN repository in `getOption("repos")`.
- The device listing from `dev2bitmap()` and `bitmap()` was truncated to 1000 characters: modern versions of GhostScript on most platforms have many more devices.
- (Windows.) Commands such as `Sys.which()` and `pipe()` which needed to find the full path to a command could segfault if the 'long' path name was much longer than the 'short' path name (which `Sys.which()` returns), as the behaviour of the Windows API call had changed.
- `R CMD build` will fail with an error if one of the packages specified in the '`VignetteBuilder`' field is not installed. (Without loading those packages it cannot be ascertained which files are intended to be vignettes. This means that the '`VignetteBuilder`' packages have to be installed for package checking too.) (Wish of PR#15775.)
- Misguided attempts to use `chull()` with non-finite points now give an error (related to PR#15777).
- For a formula with exactly 32 variables the 32nd variable was aliased to the intercept in some C-level computations of terms, so that for example attempting to remove it would remove the intercept instead (and leave a corrupt internal structure). (PR#15735)
- `anyDuplicated()` silently returned wrong values when the first duplicate was at an index which was too large to be stored in an integer vector (although a lot of RAM and patience would have been needed to encounter this).
- `tools::Rd2ex(commentDontrun = FALSE)` failed if the block had only one line.

- Hexadecimal constants such as `0x110p-5L` which were incorrectly qualified by `L` were parsed incorrectly since R 3.0.0, with a slightly garbled warning. (PR#15753)
- `system()` returned success on some platforms even if the system was unable to launch a process. (PR#15796)
- (Windows `Rgui` console.) Unbuffered output was sometimes not output immediately if the prompt was not on the last line of the console.
- The built-in help server did not declare the encoding for the '`DESCRIPTION`' or other text files to be the package encoding, so non-ASCII characters could be displayed incorrectly.
- R is now trying harder to not cleanup child processes that were not spawned by `mcparallel()` on platforms that provide information about the source process of the `SIGCHLD` signal. This allows 3rd party libraries to manage the exit status of children that they spawn without R interfering.
- `mcmapply()` was only parallelizing if the number of jobs was bigger than the number of cores. It now parallelizes if the number of jobs is more than one.
- Auto-printing would re-evaluate its argument when trying to dispatch to a print method. This is now avoided when possible.
- Unserializing (including `load()` and `readRDS()`) could silently return incorrect numeric values from ASCII saves if there was a read error.
- `getParseData()` could return incorrect values for the parents of some elements. (Reported by Andrew Redd.)
- Attempting to use data frames of 2^31 or more rows with `merge()` or to create a merged data frame of that size now gives a clearer error message.
- `parse()` did not check its `file` argument was a connection if it was not a character string, so e.g. `parse(FALSE)` attempted to read from `stdin`.
  Nor did `dump()` and `dput()`.
- The `"help.try.all.packages"` option was ignored when the shortcut syntax for help was used, e.g. `?foo`.
- A potential segfault in string allocation has been fixed. (Found by Radford Neal.)
- Potential memory protection errors in `sort()` and `D()` have been fixed. (Found by Radford Neal.)
- Fixed a lack of error checking in graphics event functions. (Found by Radford Neal; a different patch used here than the one in pqR.)
- `numericDeriv()` sometimes miscalculated the gradient. (PR#15849, reported originally by Radford Neal)



CHANGES IN R 3.1.0

NEW FEATURES:

- `type.convert()` (and hence by default `read.table()`) returns a character vector or factor when representing a numeric input as a double would lose accuracy. Similarly for complex inputs.
  If a file contains numeric data with unrepresentable numbers of decimal places that are intended to be read as numeric, specify `colClasses` in `read.table()` to be `"numeric"`.
- `tools::Rdiff(useDiff = FALSE)` is closer to the POSIX definition of `diff -b` (as distinct from the description in the `man` pages of most systems).
- New function `anyNA()`, a version of `any(is.na(.))` which is fast for atomic vectors, based on a proposal by Tim Hesterberg. (Wish of PR#15239.)

- `arrayInd(*,useNames = TRUE)` and, analogously, `which(*,arr.ind = TRUE)` now make use of `names(.dimnames)` when available.
- `is.unsorted()` now also works for `raw` vectors.
- The `"table"` method for `as.data.frame()` (also useful as `as.data.frame.table()`) now passes `sep` and `base` arguments to `provideDimnames()`.
- `uniroot()` gets new optional arguments, notably `extendInt`, allowing to auto-extend the search interval when needed. The return value has an extra component, `init.it`.
- `switch(f,...)` now warns when `f` is a factor, as this typically happens accidentally where the useR meant to pass a character string, but `f` is treated as integer (as always documented).
- The parser has been modified to use less memory.
- The way the unary operators (`+ -!`) handle attributes is now more consistent. If there is no coercion, all attributes (including class) are copied from the input to the result: otherwise only names, dims and dimnames are.
- `colorRamp()` and `colorRampPalette()` now allow non-opaque colours and a ramp in opacity *via* the new argument `alpha = TRUE`. (Suggested by Alberto Krone-Martins, but optionally as there are existing uses which expect only RGB values.)
- `grid.show.layout()` and `grid.show.viewport()` get an optional `vp.ex` argument.
- There is a new function `find_gs_cmd()` in the **tools** package to locate a GhostScript executable. (This is an enhanced version of a previously internal function there.)
- `object.size()` gains a `format()` method.
- There is a new family, `"ArialMT"`, for the `pdf()` and `postscript()` devices. This will only be rendered correctly on viewers which have access to Monotype TrueType fonts (which are sometimes requested by journals).
- The text and PDF news files, including '`NEWS`' and '`NEWS.2`', have been moved to the '`doc`' directory.
- `combn(x,simplify = TRUE)` now gives a factor result for factor input `x` (previously user error). (Related to PR#15442.)
- Added `utils::fileSnapshot()` and `utils::changedFiles()` functions to allow snapshots and comparison of directories of files.
- `make.names(names,unique=TRUE)` now tries to preserve existing names. (Suggestion of PR#15452.)
- New functions `cospi(x)`, `sinpi(x)`, and `tanpi(x)`, for more accurate computation of `cos(pi*x)`, etc, both in R and the C API. Using these gains accuracy in some cases, e.g., inside `lgamma()` or `besselI()`. (Suggested by Morten Welinder in PR#15529.)
- `print.table(x,zero.print = ".")` now also has an effect when `x` is not integer-valued.
- There is more support to explore the system's idea of time-zone names. `Sys.timezone()` tries to give the current system setting by name (and succeeds at least on Linux, OS X, Solaris and Windows), and `OlsonNames()` lists the names in the system's Olson database. `Sys.timezone(location = FALSE)` gives the previous behaviour.
- Platforms with a 64-bit `time_t` type are allowed to handle conversions between the `"POSIXct"` and `"POSIXlt"` classes for date-times outside the 32-bit range (before 1902 or after 2037): the existing workarounds are used on other platforms. (Note that time-zone information for post-2037 is speculative at best, and the OS services are tested for known errors and so not used on OS X.)
  Currently `time_t` is usually `long` and hence 64-bit on Unix-alike 64-bit platforms: however in several cases the time-zone database is 32-bit. For R for Windows it is 64-bit (for both architectures as from this version).

- The "save.defaults" option can include a value for compression_level. (Wish of PR#15579.)
- colSums() and friends now have support for arrays and data-frame columns with 2^{31} or more elements.
- as.factor() is faster when f is an unclassed integer vector (for example, when called from tapply()).
- fft() now works with longer inputs, from the 12 million previously supported up to 2 billion. (PR#15593)
- Complex svd() now uses LAPACK subroutine ZGESDD, the complex analogue of the routine used for the real case.
- Sweave now outputs '.tex' files in UTF-8 if the input encoding is declared to be UTF-8, regardless of the local encoding. The UTF-8 encoding may now be declared using a LaTeX comment containing the string %\SweaveUTF8 on a line by itself.
- file.copy() gains a copy.date argument.
- Printing of date-times will make use of the time-zone abbreviation in use at the time, if known. For example, for Paris pre-1940 this could be 'LMT', 'PMT', 'WET' or 'WEST'. To enable this, the "POSIXlt" class has an optional component "zone" recording the abbreviation for each element.
  For platforms which support it, there is also a component "gmtoff" recording the offset from GMT where known.
- (On Windows, by default on OS X and optionally elsewhere.) The system C function strftime has been replaced by a more comprehensive version with closer conformance to the POSIX 2008 standard.
- dnorm(x,log = FALSE) is more accurate (but somewhat slower) for —x— ¿ 5; as suggested in PR#15620.
- Some versions of the tiff() device have further compression options.
- read.table(), readLines() and scan() have a new argument to influence the treatment of embedded nuls.
- Avoid duplicating the right hand side values in complex assignments when possible. This reduces copying of replacement values in expressions such as Z$a <-a0 and ans[[i]] <-tmp: some package code has relied on there being copies.
  Also, a number of other changes to reduce copying of objects; all contributed by or based on suggestions by Michael Lawrence.
- The fast argument of KalmanLike(), KalmanRun() and KalmanForecast() has been replaced by update, which instead of updating mod in place, optionally returns the updated model in an attribute "mod" of the return value.
- arima() and makeARIMA() get a new optional argument SSinit, allowing the choice of a different state space initialization which has been observed to be more reliable close to non-stationarity: see PR#14682.
- warning() has a new argument noBreaks., to simplify post-processing of output with options(warn = 1).
- pushBack() gains an argument encoding, to support reading of UTF-8 characters using scan(), read.table() and related functions in a non-UTF-8 locale.
- all.equal.list() gets a new argument use.names which by default labels differing components by names (if they match) rather than by integer index. Saved R output in packages may need to be updated.
- The methods for all.equal() and attr.all.equal() now have argument check.attributes after ... so it cannot be partially nor positionally matched (as it has been, unintentionally).

A side effect is that some previously undetected errors of passing empty arguments (no object between commas) to `all.equal()` are detected and reported.
There are explicit checks that `check.attributes` is logical, `tolerance` is numeric and `scale` is `NULL` or numeric. This catches some unintended positional matching.
The message for `all.equal.numeric()` reports a `"scaled difference"` only for `scale != 1`.

- `all.equal()` now has a `"POSIXt"` method replacing the `"POSIXct"` method.
- The `"Date"` and `"POSIXt"` methods of `seq()` allows `by = "quarter"` for completeness (`by = "3 months"` always worked).
- `file.path()` removes any trailing separator on Windows, where they are invalid (although sometimes accepted). This is intended to enhance the portability of code written by those using POSIX file systems (where a trailing `/` can be used to confine path matching to directories).
- New function `agrepl()` which like `grepl()` returns a logical vector.
- `fifo()` is now supported on Windows. (PR#15600)
- `sort.list(method = "radix")` now allows negative integers (wish of PR#15644).
- Some functionality of `print.ts()` is now available in `.preformat.ts()` for more modularity.
- `mcparallel()` gains an option `detach = TRUE` which allows execution of code independently of the current session. It is based on a new `estranged = TRUE` argument to `mcfork()` which forks child processes such that they become independent of the parent process.
- The `pdf()` device omits circles and text at extremely small sizes, since some viewers were failing on such files.
- The rightmost break for the `"months"`, `"quarters"` and `"years"` cases of `hist.POSIXlt()` has been increased by a day. (Inter alia, fixes PR#15717.)
- The handling of `DF[i,] <-a` where `i` is of length 0 is improved. (Inter alia, fixes PR#15718.)
- `hclust()` gains a new method `"ward.D2"` which implements Ward's method correctly. The previous `"ward"` method is `"ward.D"` now, with the old name still working. Thanks to research and proposals by Pierre Legendre.
- The `sunspot.month` dataset has been amended and updated from the official source, whereas the `sunspots` and `sunspot.year` datasets will remain immutable. The documentation and source links have been updated correspondingly.
- The `summary()` method for `"lm"` fits warns if the fit is essentially perfect, as most of the summary may be computed inaccurately (and with platform-dependent values). Programmers who use `summary()` in order to extract just a component which will be reliable (e.g., `$cov.unscaled`) should wrap their calls in `suppressWarnings()`.

INSTALLATION and INCLUDED SOFTWARE:

- The included version of LAPACK has been updated to 3.5.0.
- There is some support for parallel testing of an installation, by setting `TEST_MC_CORES` to an integer greater than one to indicate the maximum number of cores to be used in parallel. (It is worth specifying at least 8 cores if available.) Most of these require a `make` program (such as GNU `make` and `dmake`) which supports the `$MAKE -j nproc` syntax.
  Except on Windows: the tests of standard package examples in `make check` are done in parallel. This also applies to running `tools::testInstalledPackages()`.
  The more time-consuming regression tests are done in parallel.
  The package checks in `make check-devel` and `make check-recommended` are done in parallel.

- More of `make check` will work if recommended packages are not installed: but recommended packages remain needed for thorough checking of an R build.
- The version of '`tzcode`' included in '`src/extra/tzone`' has been updated. (Formerly used only on Windows.)
- The included (64-bit) time-zone conversion code and Olson time-zone database can be used instead of the system version: use `configure` option '`--with-internal-tzcode`'. This is the default on Windows and OS X. (Note that this does not currently work if a non-default `rsharedir configure` variable is used.) (It might be necessary to set environment variable `TZ` on OSes where this is not already set, although the system timezone is deduced correctly on at least Linux, OS X and Windows.)
  This option also switches to the version of `strftime` included in directory '`src/extra/tzone`'.
- `configure` now tests for a C++11-compliant compiler by testing some basic features. This by default tries flags for the compiler specified by '`CXX`', but an alternative compiler, options and standard can be specified by variables '`CXX1X`', '`CXX1XFLAGS`' and '`CXX1XSTD`' (e.g., '`-std=gnu++11`').
- R can now optionally be compiled to use reference counting instead of the `NAMED` mechanism by defining `SWITCH_TO_REFCNT` in '`Rinternals.h`'. This may become the default in the future.
- There is a new option '`--use-system-tre`' to use a suitable system **tre** library: at present this means a version from their `git` repository, after corrections. (Wish of PR#15660.)

PACKAGE INSTALLATION:

- The `CRANextra` repository is no longer a default repository on Windows: all the binary versions of packages from CRAN are now on CRAN, although `CRANextra` contains packages from Omegahat and elsewhere used by CRAN packages.
- Only vignettes sources in directory '`vignettes`' are considered to be vignettes and hence indexed as such.
- In the '`DESCRIPTION`' file,

  ```
  License: X11
  ```

  is no longer recognized as valid. Use '`MIT`' or '`BSD_2_clause`' instead, both of which need '`+ file LICENSE`'.
- For consistency, entries in '`.Rinstignore`' are now matched case-insensitively on all platforms.
- Help for S4 methods with very long signatures now tries harder to split the description in the '`Usage`' field to no more than 80 characters per line (some packages had over 120 characters).
- `R CMD INSTALL --build` (not Windows) now defaults to the internal `tar()` unless `R_INSTALL_TAR` is set.
- There is support for compiling C++11 code in packages on suitable platforms: see 'Writing R Extensions'.
- Fake installs now install the contents of directory '`inst`': some packages use this to install e.g. C++ headers for use by other packages that are independent of the package itself. Option '`--no-inst`' can be used to get the previous behaviour.

DEBUGGING:

- The behaviour of the code browser has been made more consistent, in part following the suggestions in PR#14985.

- Calls to `browser()` are now consistent with calls to the browser triggered by `debug()`, in that *`Enter`* will default to `n` rather than `c`.
- A new browser command `s` has been added, to "step into" function calls.
- A new browser command `f` has been added, to "finish" the current loop or function.
- Within the browser, the command `help` will display a short list of available commands.

UTILITIES:

- Only vignettes sources in directory '`vignettes`' are considered to be vignettes by `R CMD check`. That has been the preferred location since R 2.14.0 and is now obligatory.
- For consistency, `R CMD build` now matches entries in '`.Rbuildignore`' and '`vignettes/.install_extras`' case-insensitively on all platforms (not just on Windows).
- `checkFF()` (called by `R CMD check` by default) can optionally check foreign function calls for consistency with the registered type and argument count. This is the default for `R CMD check --as-cran` or can be enabled by setting environment variable `_R_CHECK_FF_CALLS_` to '`registration`' (but is in any case suppressed by '`--install=no`'). Because this checks calls in which `.NAME` is an R object and not just a literal character string, some other problems are detected for such calls.
  Functions `suppressForeignCheck()` and `dontCheck()` have been added to allow package authors to suppress false positive reports.
- `R CMD check --as-cran` warns about a false value of the '`DESCRIPTION`' field '`BuildVignettes`' for Open Source packages, and ignores it. (An Open Source package needs to have complete sources for its vignettes which should be usable on a suitably well-equipped system).
- `R CMD check --no-rebuild-vignettes` is defunct:
  `R CMD check --no-build-vignettes` has been preferred since R 3.0.0.
- `R CMD build --no-vignettes` is defunct:
  `R CMD build --no-build-vignettes` has been preferred since R 3.0.0.
- `R CMD Sweave` and `R CMD Stangle` now process both Sweave and non-Sweave vignettes. The `tools::buildVignette()` function has been added to do the same tasks from within R.
- The flags returned by `R CMD config --ldflags` and (where installed) `pkg-config --libs libR` are now those needed to link a front-end against the (shared or static) R library.
- '`Sweave.sty`' has a new option '`[inconsolata]`'.
- `R CMD check` customizations such as `_R_CHECK_DEPENDS_ONLY_` make available packages only in '`LinkingTo`' only for installation, and not for loading/runtime tests.
- `tools::checkFF()` reports on `.C` and `.Fortran` calls with `DUP = FALSE` if argument `check_DUP` is true. This is selected by `R CMD check` by default.
- `R CMD check --use-gct` can be tuned to garbage-collect less frequently using `gctorture2()` *via* the setting of environment variable `_R_CHECK_GCT_N_`.
- Where supported, `tools::texi2dvi()` limits the number of passes tried to 20.

C-LEVEL FACILITIES:

- (Windows only) A function `R_WaitEvent()` has been added (with declaration in header'`R.h`') to block execution until the next event is received by R.
- Remapping in the '`Rmath.h`' header can be suppressed by defining '`R_NO_REMAP_RMATH`'.
- The remapping of `rround()` in header '`Rmath.h`' has been removed: use `fround()` instead.

- `ftrunc()` in header '`Rmath.h`' is now a wrapper for the C99 function `trunc()`, which might as well be used in C code: `ftrunc()` is still needed for portable C++ code.
- The never-documented remapping of `prec()` to `fprec()` in header '`Rmath.h`' has been removed.
- The included LAPACK subset now contains `ZGESDD` and `ZGELSD`.
- The function `LENGTH()` now checks that it is only applied to vector arguments. However, in packages `length()` should be used. (In R itself `LENGTH()` is a macro without the function overhead of `length()`.)
- Calls to `SET_VECTOR_ELT()` and `SET_STRING_ELT()` are now checked for indices which are in-range: several packages were writing one element beyond the allocated length.
- `allocVector3` has been added which allows custom allocators to be used for individual vector allocations.

DEPRECATED AND DEFUNCT:

- `chol(pivot = TRUE,LINPACK = TRUE)` is defunct.
  Arguments `EISPACK` for `eigen()` and `LINPACK` for `chol()`, `chol2inv()`, `solve()` and `svd()` are ignored: LAPACK is always used.
- `.find.package()` and `.path.package()` are defunct: only the versions without the initial dot introduced in R 2.13.0 have ever been in the API.
- Partial matching when using the `$` operator *on data frames* now throws a warning and may become defunct in the future. If partial matching is intended, replace `foo$bar` by `foo[["bar",exact = FALSE]]`.
- The long-deprecated use of `\synopsis` in the '`Usage`' section of '`.Rd`' files has been removed: such sections are now ignored (with a warning).
- `package.skeleton()`'s deprecated argument `namespace` has been removed.
- Many methods are no longer exported by package **stats**. They are all registered on their generic, which should be called rather than calling a method directly.
- Functions `readNEWS()` and `checkNEWS()` in package **tools** are defunct.
- `download.file(method = "lynx")` is deprecated.
- `.C(DUP = FALSE)` and `.Fortran(DUP = FALSE)` are now deprecated, and may be disabled in future versions of R. As their help has long said, `.Call()` is much preferred. `R CMD check` notes such usages (by default).
- The workaround of setting `R_OSX_VALGRIND` has been removed: it is not needed in current valgrind.

BUG FIXES:

- Calling `lm.wfit()` with no non-zero weights gave an array-overrun in the Fortran code and a not very sensible answer. It is now special-cased with a simpler answer (no `qr` component).
- Error messages involving non-syntactic names (e.g., as produced by `` `\r` `` when that object does not exist) now encode the control characters. (Reported by Hadley Wickham.)
- `getGraphicsEvent()` caused 100% usage of one CPU in Windows. (PR#15500)
- `nls()` with no `start` argument may now work inside another function (scoping issue).
- `pbeta()` and similar work better for very large (billions) `ncp`.
- Where time zones have changed abbreviations over the years, the software tries to more consistently use the abbreviation appropriate to the time or if that is unknown, the current abbreviation. On some platforms where the C function `localtime` changed the `tzname` variables the reported abbreviation could have been that of the last time converted.

- `all.equal(list(1),identity)` now works.
- Bug fix for pushing viewports in **grid** (reported by JJ Allaire and Kevin Ushey). NOTE for anyone poking around within the graphics engine display list (despite the warnings not to) that this changes what is recorded by **grid** on the graphics engine display list.
- Extra checks have been added for unit resolution and conversion in **grid**, to catch instances of division-by-zero. This may introduce error messages in existing code and/or produce a different result in existing code (but only where a non-finite location or dimension may now become zero).
- Some bugs in TRE have been corrected by updating from the `git` repository. This allows R to be installed on some platforms for which this was a blocker (PR#15087 suggests Linux on ARM and HP-UX).
- `?` applied to a call to an S4 generic failed in several cases. (PR#15680)
- The implicit S4 generics for primitives with `...` in their argument list were incorrect. (PR#15690)
- Bug fixes to `methods::callGeneric()`. (PR#15691)
- The bug fix to `aggregate()` in PR#15004 introduced a new bug in the case of no grouping variables. (PR#15699)
- In rare cases printing deeply nested lists overran a buffer by one byte and on a few platforms segfaulted. (PR#15679)
- The dendrogram method of `as.dendrogram()` was hidden accidentally, (PR#15703), and `order.dendrogram(d)` gave too much for a leaf `d`. (PR#15702)
- R would try to kill processes on exit that have pids ever used by a child process spawned by `mcparallel` even though the current process with that pid was not actually its child.
- `cophenetic()` applied to a `"dendrogram"` object sometimes incorrectly returned a `"Labels"` attribute with dimensions. (PR#15706)
- `printCoefmat()` called from quite a few `print()` methods now obeys small `getOption("width")` settings, line wrapping the '`"signif. codes"`' legend appropriately. (PR#15708)
- `model.matrix()` assumed that the stored dimnames for a matrix was `NULL` or length 2, but length 1 occurred.
- The clipping region for a device was sometimes used in base graphics before it was set.



CHANGES IN R 3.0.3

NEW FEATURES:

- On Windows there is support for making '`.texi`' manuals using `texinfo` 5.0 or later: the setting is in file '`src/gnuwin32/MkRules.dist`'.
  A packaging of the Perl script and modules for `texinfo` 5.2 has been made available at `http://www.stats.ox.ac.uk/pub/Rtools/`.
- `write.table()` now handles matrices of 2^{31} or more elements, for those with large amounts of patience and disc space.
- There is a new function, `La_version()`, to report the version of LAPACK in use.
- The HTML version of 'An Introduction to R' now has links to PNG versions of the figures.
- There is some support to produce manuals in ebook formats. (See '`doc/manual/Makefile`'. Suggested by Mauro Cavalcanti.)

- On a Unix-alike `Sys.timezone()` returns `NA` if the environment variable `TZ` is unset, to distinguish it from an empty string which on some OSes means the '`UTC`' time zone.
- The backtick may now be escaped in strings, to allow names containing them to be constructed, e.g. `` `\`` ``. (PR#15621)
- `read.table()`, `readLines()` and `scan()` now warn when an embedded nul is found in the input. (Related to PR#15625 which was puzzled by the behaviour in this unsupported case.)
- (Windows only.) `file.symlink()` works around the undocumented restriction of the Windows system call to backslashes. (Wish of PR#15631.)
- `KalmanForecast(fast = FALSE)` is now the default, and the help contains an example of how `fast = TRUE` can be used in this version. (The usage will change in 3.1.0.)
- `strptime()` now checks the locale only when locale-specific formats are used and caches the locale in use: this can halve the time taken on OSes with slow system functions (e.g., OS X).
- `strptime()` and the `format()` methods for classes `"POSIXct"`, `"POSIXlt"` and `"Date"` recognize strings with marked encodings: this allows, for example, UTF-8 French month names to be read on (French) Windows.
- `iconv(to = "utf8")` is now accepted on all platforms (some implementations did already, but GNU **libiconv** did not: however converted strings were not marked as being in UTF-8). The official name, `"UTF-8"` is still preferred.
- `available.packages()` is better protected against corrupt metadata files. (A recurring problem with Debian package **shogun-r**: PR#14713.)
- Finalizers are marked to be run at garbage collection, but run only at a somewhat safer later time (when interrupts are checked). This circumvents some problems with finalizers running arbitrary code during garbage collection (the known instances being running `options()` and (C-level) `path.expand()` re-entrantly).

INSTALLATION and INCLUDED SOFTWARE:

- The included version of PCRE has been updated to 8.34. This fixes bugs and makes the behaviour closer to Perl 5.18. In particular, the concept of 'space' includes '`VT`' and hence agrees with POSIX's.

PACKAGE INSTALLATION:

- The new field '`SysDataCompression`' in the '`DESCRIPTION`' file allows user control over the compression used for '`sysdata.rda`' objects in the lazy-load database.
- `install.packages(dependencies = value)` for `value = NA` (the default) or `value = TRUE` omits packages only in `LinkingTo` for binary package installs.

C-LEVEL FACILITIES:

- The long undocumented remapping of `rround()` to `Rf_fround()` in header '`Rmath.h`' is now formally deprecated: use `fround()` directly.
- Remapping of `prec()` and `trunc()` in the '`Rmath.h`' header has been disabled in C++ code (it has caused breakage with `libc++` headers).

BUG FIXES:

- `getParseData()` truncated the imaginary part of complex number constants. (Reported by Yihui Xie.)
- `dbeta(x,a,b)` with `a` or `b` within a factor of 2 of the largest representable number could infinite-loop. (Reported by Ioannis Kosmidis.)
- `provideDimnames()` failed for arrays with a 0 dimension. (PR#15465)

- `rbind()` and `cbind()` did not handle list objects correctly. (PR#15468)
- `replayPlot()` now checks if it is replaying a plot from the same session.
- `rasterImage()` and `grid.raster()` now give error on an empty (zero-length) raster. (Reported by Ben North.)
- `plot.lm()` would sometimes scramble the labels in plot type 5. (PR#15458 and PR#14837)
- `min()` did not handle `NA_character_` values properly. (Reported by Magnus Thor Torfason.)
- (Windows only.) `readRegistry()` would duplicate default values for keys. (PR#15455)
- `str(...,strict.width = "cut")` did not handle it properly when more than one line needed to be cut. (Reported by Gerrit Eichner.)
- Removing subclass back-references when S4 classes were removed or their namespace unloaded had several bugs (e.g., PR#15481).
- `aggregate()` could fail when there were too many levels present in the `by` argument. (PR#15004)
- `namespaceImportFrom()` needed to detect primitive functions when checking for duplicated imports (reported by Karl Forner).
- `getGraphicsEvent()` did not exit when a user closed the graphics window. (PR#15208)
- Errors in vignettes were not always captured and displayed properly. (PR#15495)
- `contour()` could fail when dealing with extremely small z values. (PR#15454)
- Several functions did not handle zero-length vectors properly, including `browseEnv()`, `format()`, `gl()`, `relist()` and `summary.data.frame()`. (E.g., PR#15499)
- `Sweave()` did not restore the R output to the console if it was interrupted by a user in the middle of evaluating a code chunk. (Reported by Michael Sumner.)
- Fake installs of packages with vignettes work again.
- Illegal characters in the input caused `parse()` (and thus `source()`) to segfault. (PR#15518)
- The nonsensical use of `nmax = 1` in `duplicated()` or `unique()` is now silently ignored.
- `qcauchy(p,*)` is now fully accurate even when p is very close to 1. (PR#15521)
- The `validmu()` and `valideta()` functions in the standard `glm()` families now also report non-finite values, rather than failing.
- Saved vignette results (in a '`.Rout.save`' file) were not being compared to the new ones during `R CMD check`.
- Double-clicking outside of the list box (e.g., on the scrollbar) of a Tk listbox widget generated by `tk_select.list()` no longer causes the window to close. (PR#15407)
- Improved handling of edge cases in `parallel::splitindices()`. (PR#15552)
- HTML display of results from `help.search()` and `??` sometimes contained badly constructed links.
- `c()` and related functions such as `unlist()` converted raw vectors to invalid logical vectors. (PR#15535)
- (Windows only) When a call to `system2()` specified one of `stdin`, `stdout` or `stderr` to be a file, but the command was not found (e.g., it contained its arguments, or the program was not on the `PATH`), it left the file open and unusable until R terminated. (Reported by Mathew McLean.)
- The `bmp()` device was not recording `res = NA` correctly: it is now recorded as 72 ppi.
- Several potential problems with compiler-specific behaviour have been identified using the 'Undefined Behaviour Sanitizer' in conjunction with the `clang` compiler.

- `hcl()` now honours `NA` inputs (previously they were mapped to black).
- Some translations in base packages were being looked up in the main catalog rather than that for the package.
- As a result of the 3.0.2 change about 'the last second before the epoch', most conversions which should have given `NA` returned that time. (The platforms affected include Linux and OS X, but not Windows nor Solaris.)
- `rowsum()` has more support for matrices and data frames with 2^{31} or more elements. (PR#15587)
- `predict(<lm object>,interval = "confidence",scale = <something>)` now works. (PR#15564)
- The bug fix in 3.0.2 for PR#15411 was too aggressive, and sometimes removed spaces that should not have been removed. (PR#15583)
- Running R code in a **tcltk** callback failed to set the busy flag, which will be needed to tell OS X not to 'App Nap'.
- The code for date-times before 1902 assumed that the offset from GMT in 1902 was a whole number of minutes: that was not true of Paris (as recorded on some platforms).
- Using `Sys.setlocale` to set `LC_NUMERIC` to `"C"` (to restore the sane behavior) no longer gives a warning.
- `deparse()` now deparses complex vectors in a way that re-parses to the original values. (PR#15534, patch based on code submitted by Alex Bertram.)
- In some extreme cases (more than 10^{15}) integer inputs to `dpqrxxx()` functions might have been rounded up by one (with a warning about being non-integer). (PR#15624)
- Plotting symbol `pch = 14` had the triangle upside down on some devices (typically screen devices). The triangle is supposed to be point up. (Reported by Bill Venables.)
- `getSrcref()` did not work on method definitions if `rematchDefinition()` had been used.
- `KalmanForecast(fast = FALSE)` reported a (harmless) stack imbalance.
- The count of observations used by `KalmanRun()` did not take missing values into account.
- In locales where the abbreviated name of one month is a partial match for the full name of a later one, the `%B` format in `strptime()` could fail. An example was French on OS X, where '`juin`' is abbreviated to '`jui`' and partially matches `juillet`. Similarly for weekday names.
- `pbeta(x,a,b,log.p = TRUE)` sometimes underflowed to zero for very small and very differently sized `a`, `b`. (PR#15641)
- `approx()` and `approxfun()` now handle infinite values with the `"constant"` method. (PR#15655)
- `stripchart()` again respects reversed limits in `xlim` and `ylim`. (PR#15664)



CHANGES IN R 3.0.2

NEW FEATURES:

- The '`NEWS`' files have been re-organized.
  This file contains news for R ¿= 3.0.0: news for the 0.x.y, 1.x.y and 2.x.y releases is in files '`NEWS.0`', '`NEWS.1`' and '`NEWS.2`'. The latter files are now installed when R is installed. An HTML version of news from 2.10.0 to 2.15.3 is available as '`doc/html/NEWS.2.html`'.

- `sum()` for integer arguments now uses an integer accumulator of at least 64 bits and so will be more accurate in the very rare case that a cumulative sum exceeds 2^{53} (necessarily summing more than 4 million elements).
- The `example()` and `tools::Rd2ex()` functions now have parameters to allow them to ignore `\dontrun` markup in examples. (Suggested by Peter Solymos.)
- `str(x)` is considerably faster for very large lists, or factors with 100,000 levels, the latter as in PR#15337.
- `col2rgb()` now converts factors to character strings not integer codes (suggested by Bryan Hanson).
- `tail(warnings())` now works, *via* the new `` `[` `` method.
- There is now support for the LaTeX style file '`zi4.sty`' which has in some distributions replaced '`inconsolata.sty`'.
- `unlist(x)` now typically returns all non-list `x`s unchanged, not just the "vector" ones. Consequently, `format(lst)` now also works when the list `lst` has non-vector elements.
- The `tools::getVignetteInfo()` function has been added to give information about installed vignettes.
- New `assertCondition()`, etc. utilities in **tools**, useful for testing.
- Profiling now records non-inlined calls from byte-compiled code to `BUILTIN` functions.
- Various functions in **stats** and elsewhere that use non-standard evaluation are now more careful to follow the namespace scoping rules. E.g., `stats::lm()` can now find `stats::model.frame()` even if **stats** is not on the search path or if some package defines a function of that name.
- If an invalid/corrupt `.Random.seed` object is encountered in the workspace it is ignored with a warning rather than giving an error. (This allows R itself to rely on a working RNG, e.g. to choose a random port.)
- `seq()` and `seq.int()` give more explicit error messages if called with invalid (e.g., `NaN`) inputs.
- When `parse()` finds a syntax error, it now makes partial parse information available up to the location of the error. (Request of Reijo Sund.)
- Methods invoked by `NextMethod()` had a different dynamic parent to the generic. This was causing trouble where S3 methods invoked *via* lazy evaluation could lose track of their generic. (PR#15267)
- Code for the negative binomial distribution now treats the case `size == 0` as a one-point distribution at zero.
- `abbreviate()` handles without warning non-ASCII input strings which require no abbreviation.
- `read.dcf()` no longer has a limit of 8191 bytes per line. (Wish of PR#15250.)
- `formatC(x)` no longer copies the class of `x` to the result, to avoid misuse creating invalid objects as in PR#15303. A warning is given if a class is discarded.
- Dataset `npk` has been copied from **MASS** to allow more tests to be run without recommended packages being installed.
- The initialization of the regression coefficients for non-degenerate differenced models in `arima()` has been changed and in some examples avoids a local maximum. (PR#15396)
- `termplot()` now has an argument `transform.x` to control the display of individual terms in the plot. (PR#15329)
- `format()` now supports `digits = 0`, to display `nsmall` decimal places.
- There is a new read-only `par()` parameter called `"page"`, which returns a logical value indicating whether the next `plot.new()` call will start a new page.

- Processing Sweave and Rd documents to PDF now renders backticks and single quotes better in several instances, including in '\code' and '\samp' expressions.
- utils::modifyList() gets a new argument keep.null allowing NULL components in the replacement to be retained, instead of causing corresponding components to be deleted.
- tools::pkgVignettes() gains argument check; if set to TRUE, it will warn when it appears a vignette requests a non-existent vignette engine.

UTILITIES:

- R CMD check --as-cran checks the line widths in usage and examples sections of the package Rd files.
- R CMD check --as-cran now implies '--timings'.
- R CMD check looks for command gfile if a suitable file is not found. (Although file is not from GNU, OpenCSW on Solaris installs it as gfile.)
- R CMD build (with the internal tar) checks the permissions of 'configure' and 'cleanup' files and adds execute permission to the recorded permissions for these files if needed, with a warning. This is useful on OSes and file systems which do not support execute permissions (notably, on Windows).
- R CMD build now weaves and tangles all vignettes, so suggested packages are not required during package installation if the source tarball was prepared with current R CMD build.
- checkFF() (used by R CMD check) does a better job of detecting calls from other packages, including not reporting those where a function has been copied from another namespace (e.g., as a default method). It now reports calls where .NAME is a symbol registered in another package.
- On Unix-alike systems, R CMD INSTALL now installs packages group writably whenever the library (lib.loc) is group writable. Hence, update.packages() works for other group members (suggested originally and from a patch by Dirk Eddelbuettel).
- R CMD javareconf now supports the use of symbolic links for JAVA_HOME on platforms which have realpath. So it is now possible to use

  ```
  R CMD javareconf JAVA_HOME=/usr/lib/jvm/java-1.7.0
  ```

  on a Linux system and record that value rather than the frequently-changing full path such as '/usr/lib/jvm/java-1.7.0-openjdk-1.7.0.25.x86_64'.
- (Windows only.) Rscript -e requires a non-empty argument for consistency with Unix versions of R. (Also Rterm -e and R -e.)
- R CMD check does more thorough checking of declared packages and namespaces. It reports
  - packages declared in more than one of the 'Depends', 'Imports', 'Suggests' and 'Enhances' fields of the 'DESCRIPTION' file.
  - namespaces declared in 'Imports' but not imported from, neither in the 'NAMESPACE' file nor using the :: nor ::: operators.
  - packages which are used in library() or requires() calls in the R code but were already put on the search path *via* 'Depends'.
  - packages declared in 'Depends' not imported *via* the 'NAMESPACE' file (except the standard packages). Objects used from 'Depends' packages should be imported to avoid conflicts and to allow correct operation when the namespace is loaded but not attached.
  - objects imported *via* ::: calls where :: would do.
  - objects imported by :: which are not exported.

  - objects imported by `:::` calls which do not exist.

  See 'Writing R Extensions' for good practice.
- `R CMD check` optionally checks for non-standard top-level files and directories (which are often mistakes): this is enabled for '`--as-cran`'.
- LaTeX style file `upquote.sty` is no longer included (the version was several years old): it is no longer used in R. A much later version is commonly included in LaTeX distributions but does not play well with the `ae` fonts which are the default for Sweave vignettes.
- `R CMD build` makes more use of the '`build`' sub-directory of package sources, for example to record information about the vignettes.
- `R CMD check` analyses `:::` calls.

INSTALLATION and INCLUDED SOFTWARE:

- The macros used for the texinfo manuals have been changed to work better with the incompatible changes made in `texinfo 5.x`.
- The minimum version for a system `xz` library is now 5.0.3 (was 4.999). This is in part to avoid 5.0.2, which can compress in ways other versions cannot decompress.
- The included version of PCRE has been updated to 8.33.
- The included version of `zlib` has been updated to 1.2.8, a bug-fix release.
- The included version of xz utils's `liblzma` has been updated to 5.0.5.
- Since `javareconf` (see above) is used when R is installed, a stable link for `JAVA_HOME` can be supplied then.
- Configuring with '`--disable-byte-compilation`' will override the '`DESCRIPTION`' files of recommended packages, which typically require byte-compilation.
- More of the installation and checking process will work even when `TMPDIR` is set to a path containing spaces, but this is not recommended and external software (such as `texi2dvi`) may fail.

PACKAGE INSTALLATION:

- Installation is aborted immediately if a `LinkingTo` package is not installed.
- `R CMD INSTALL` has a new option `--no-byte-compile` which will override a '`ByteCompile`' field in the package's '`DESCRIPTION`' file.
- License '`BSD`' is deprecated: use '`BSD_3_clause`' or '`BSD_2_clause`' instead.
  License '`X11`' is deprecated: use '`MIT`' or '`BSD_2_clause`' instead.
- Version requirements for `LinkingTo` packages are now recognized: they are checked at installation. (Fields with version requirements were previously silently ignored.)
- The limit of 500 `S3method` entries in a `NAMESPACE` file has been removed.
- The default 'version' of Bioconductor for its packages has been changed to the upcoming '`2.13`', but this can be set by the environment variable `R_BIOC_VERSION` when R is installed.

C-LEVEL FACILITIES:

- '`Rdefines.h`' has been tweaked so it can be included in C++ code after '`R_ext/Boolean.h`' (which is included by '`R.h`').
  Note that '`Rdefines.h`' is not kept up-to-date, and '`Rinternals.h`' is preferred for new code.
- `eval` and `applyClosure` are now protected against package code supplying an invalid `rho`.

DEPRECATED AND DEFUNCT:

- The unused `namespace` argument to `package.skeleton()` is now formally deprecated and will be removed in R 3.1.0.
- `plclust()` is deprecated: use the `plot()` method for class `"hclust"` instead.
- Functions `readNEWS()` and `checkNEWS()` in package **tools** are deprecated (and they have not worked with current '`NEWS`' files for a long time).

DOCUMENTATION:

- 'An Introduction to R' has a new chapter on using R as a scripting language including interacting with the OS.

BUG FIXES:

- `help.request()` could not determine the current version of R on CRAN. (PR#15241)
- On Windows, `file.info()` failed on root directories unless the path was terminated with an explicit `"."`. (PR#15302)
- The `regmatches<-()` replacement function mishandled results coming from `regexpr()`. (PR#15311)
- The help for `setClass()` and `representation()` still suggested the deprecated argument `representation=`. (PR#15312)
- `R CMD config` failed in an installed build of R 3.0.1 (only) when a sub-architecture was used. (Reported by Berwin Turlach.)
- On Windows, the installer modified the '`etc/Rconsole`' and '`etc/Rprofile.site`' files even when default options were chosen, so the MD5 sums did not refer to the installed versions. (Reported by Tal Galili.)
- `plot(hclust(),cex =)` respects `cex` again (and possibly others similarly). (Reported by Peter Langfelder.)
- If multiple packages were checked by `R CMD check`, and one was written for a different OS, it would set `--no-install` for all following packages as well as itself.
- `qr.coef()` and related functions did not properly coerce real vectors to complex when necessary. (PR#15332)
- `ftable(a)` now fixes up empty `dimnames` such that the result is printable.
- `package.skeleton()` was not starting its search for function objects in the correct place if `environment` was supplied. (Reported by Karl Forner.)
- Parsing code was changing the length field of vectors and confusing the memory manager. (PR#15345)
- The Fortran routine `ZHER2K` in the reference BLAS had a comment-out bug in two places. This caused trouble with `eigen()` for Hermitian matrices. (PR#15345 and report from Robin Hankin)
- `vignette()` and `browseVignettes()` did not display non-Sweave vignettes properly.
- Two warning/error messages have been corrected: the (optional) warning produced by a partial name match with a pairlist, the error message from a zero-length argument to the `:` operator. (Found by Radford Neal; PR#15358, PR#15356)
- `svd()` returned `NULL` rather than omitting components as documented. (Found by Radford Neal; PR#15360)
- `mclapply()` and `mcparallel()` with `silent = TRUE` could break a process that uses `stdout` output unguarded against broken pipes (e.g., `zip` will fail silently). To work around such issues, they now replace `stdout` with a descriptor pointed to '`/dev/null`' instead. For this purpose, internal `closeStdout` and `closeStderr` functions have gained the `to.null` flag.
- `log()`, `signif()` and `round()` now raise an error if a single named argument is not named `x`. (PR#15361)

- `deparse()` now deparses raw vectors in a form that is syntactically correct. (PR#15369)
- The `jpeg` driver in Sweave created a JPEG file, but gave it a '`.png`' extension. (PR#15370)
- Deparsing of infix operators with named arguments is improved. (PR#15350)
- `mget()`, `seq.int()` and `numericDeriv()` did not duplicate arguments properly. (PR#15352, PR#15353, PR#15354)
- `kmeans(algorithm = "Hartigan-Wong")` now always stops iterating in the QTran stage. (PR#15364).
- `read.dcf()` re-allocated incorrectly and so could segfault when called on a file with lines of more than 100 bytes.
- On systems where `mktime()` does not set `errno`, the last second before the epoch could not be converted from `POSIXlt` to `POSIXct`. (Reported by Bill Dunlap.)
- `add1.glm()` miscalculated F-statistics when df ¿ 1. (Bill Dunlap, PR#15386).
- `stem()` now discards infinite inputs rather than hanging. (PR#15376)
- The parser now enforces C99 syntax for floating point hexadecimal constants (e.g., `0x1.1p0`), rather than returning unintended values for malformed constants. (PR#15234)
- `model.matrix()` now works with very long LHS names (more than 500 bytes). (PR#15377)
- `integrate()` reverts to the pre-2.12.0 behaviour: from 2.12.0 to 3.0.1 it sometimes failed to achieve the requested tolerance and reported error estimates that were exceeded. (PR#15219)
- `strptime()` now handles '`%W`' fields with value 0. (PR#15915)
- R is now better protected against people trying to interact with the console in startup code. (PR#15325)
- Subsetting 1D arrays often lost dimnames (PR#15301).
- Unary `+` on a logical vector did not coerce to integer, although unary `-` did.
- `na.omit()` and `na.exclude()` added a row to a zero-row data frame. (PR#15399)
- All the (where necessary cut-down) vignettes are installed if R was configured with '`--without-recommended-packages`'.
- `source()` did not display filenames when reporting syntax errors.
- Syntax error reports misplaced the caret pointing out the bad token.
- (Windows only) Starting R with `R` (instead of `Rterm` or `Rgui`) would lose any zero-length strings from the command line arguments. (PR#15406)
- Errors in the encoding specified on the command line *via* `--encoding=foo` were not handled properly. (PR#15405)
- If `x` is a symbol, `is.vector(x,"name")` now returns `TRUE`, since `"name"` and `"symbol"` should be synonyms. (Reported by Hervé Pagès.)
- `R CMD rtags` works on platforms (such as OS X) with a XSI-conformant shell command `echo`. (PR#15231)
- `is.unsorted(NA)` returns false as documented (rather than `NA`).
- `R CMD LINK` did not know about sub-architectures.
- `system()` and `system2()` are better protected against users who misguidedly have spaces in the temporary directory path.
- `file.show()` and `edit()` are now more likely to work on file paths containing spaces. (Where external utilities are used, not the norm on Windows nor in `R.app` which should previously have worked.)

- Packages using the **methods** package are more likely to work when they import it but it is not attached. (Several parts of its C code were looking for its R functions on the search path rather than in its namespace.)
- `lgamma(-x)` is no longer `NaN` for very small x.
- (Windows) `system2()` now respects specifying `stdout` and `stderr` as files if called from `Rgui`. (PR#15393)
- Closing an `x11()` device whilst `locator()` or `identify()` is in progress no longer hangs R. (PR#15253)
- `list.dirs(full.names = FALSE)` was not implemented. (PR#15170)
- `format()` sometimes added unnecessary spaces. (PR#15411)
- `all.equal(check.names = FALSE)` would ignore the request to ignore the names and would check them as attributes.
- The symbol set by `tools::Rd2txt_options(itemBullet=)` was not respected in some locales. (PR#15435)
- `mcMap()` was not exported by package **parallel**. (PR#15439)
- `plot()` for `TukeyHSD` objects did not balance `dev.hold()` and `dev.flush()` calls on multi-page plots. (PR#15449)



CHANGES IN R 3.0.1

NEW FEATURES:

- `chooseCRANmirror()` and `chooseBioCmirror()` gain an `ind` argument (like `setRepositories()`).
- `mcparallel` has a new argument `mc.interactive` which can modify the interactive flag in the child process. The new default is `FALSE` which makes child processes non-interactive by default (this prevents lock-ups due to children waiting for interactive input).
- `scan()` now warns when end-of-file occurs within a quoted string.
- `count.fields()` is now consistent with `scan()` in its handling of newlines in quoted strings. Instead of triggering an error, this results in the current line receiving `NA` as the field count, with the next line getting the total count of the two lines.
- The default method of `image()` will plot axes of the class of `xlim` and `ylim` (and hence of `x` and `y` if there is a suitable `range()` method). Based on a suggestion of Michael Sumner.
- `load()` now has a `verbose` argument for debugging support, to print the names of objects just before loading them.
- When loading a serialized object encounters a reference to a namespace which cannot be loaded, this is replaced by a reference to the global environment, with a warning.
- `pairs()` gains a `line.main` option for title placement.
- The remaining instances in which serialization to a raw vector was limited to 2GB have been unlimited on a 64-bit platform, and in most cases serialization to a vector of more than 1GB will be substantially faster.

UTILITIES:

- `R CMD config` now make use of personal '`Makevars`' files under '`~/.R`' and a site file '`Makevars.site`', in the same way as `R CMD SHLIB` and `R CMD INSTALL`. This makes the utility more useful in package `configure` scripts.
  On Windows finding the personal files may require the environment variable `HOME` set.

The old behaviour can be obtained with the new options '`--no-user-files`' and '`--no-site-files`'.

PACKAGE INSTALLATION:

- Alternatives to the site and user customization files '`Makevars.site`' and '`~/.R/Makevars`' can be specified *via* the environment variables `R_MAKEVARS_SITE` and `R_MAKEVARS_USER` respectively. These can be used to suppress the use of the default files by setting an empty value (where possible) or a non-existent path.

BUG FIXES:

- `sys.source()` did not report error locations when `keep.source = TRUE`.
- `as.POSIXct.numeric` was coercing `origin` using the `tz` argument and not `"GMT"` as documented (PR#14973).
- The active binding to assign fields in reference classes has been cleaned up to reduce dependence on the class' package environment, also fixing bug in initializing read-only fields (inspired by a report from Hadley Wickham).
- `str(d)` no longer gives an error when `names(d)` contain illegal multibyte strings (PR#15247).
- Profiling of built-in functions with `line.profiling= TRUE` did not record the line from which they were called.
- `citation(pkg)` dropped the header and footer specified in the '`CITATION`' file (PR#15257).
- Quotes were handled differently when reading the first line and reading the rest, so `read.table()` misread some files that contained quote characters (PR#15245).
- `cat()` with `sep` a character vector of length greater than one and more than one argument was using separators inconsistently (PR#15261).
- On Windows in R 3.0.0, `savePlot()` failed because of an incorrect check on the argument count.
- `unzip(list = TRUE)` returned `Names` as a factor and not a character vector (as documented) for the internal method. (Noticed by Sean O'Riordain.)
- `contourLines()` now checks more comprehensively for conformance of its `x`, `y` and `z` arguments (it was used incorrectly in package **R2G2**).
- Saved graphics display lists are R version-specific. Attempting to load workspaces containing them (or some other version-specific objects) aborted the load in R 3.0.0 and earlier; now it does a partial load and generates a warning instead.
- In R 3.0.0, `identify()` and `locator()` did not record information correctly, so replaying a graph (e.g., by copying it to another device) would fail. (PR#15271)
- Calling `file.copy()` or `dirname()` with the invalid input `""` (which was being used in packages, despite not being a file path) could have caused a segfault.
  `dirname("")` is now `""` rather than `"."` (unless it segfaulted).
- `supsmu()` could read/write outside its input vectors for very short inputs (seen in package **rms** for `n = 4`).
- `as.dendrogram()`'s `hclust` method uses less memory and hence gets considerably faster for large (n ~ 1000) clusterings, thanks to Daniel Müllner. (PR#15174)
- The return value when all workers failed from `parallel::mclapply(mc.preschedule = TRUE)` was a list of strings and not of error objects. (Spotted by Karl Forner and Bernd Bischl.)
- In R 3.0.0, when `help()` found multiple pages with the same alias, the HTML display of all the selections was not produced. (PR#15282)

- `splinefun(method="monoH.FC")` now produces a function with first argument named `x` and allows `deriv=3`, as documented. (PR#15273)
- `summaryRprof()` would only read the first `chunksize` lines of an `Rprof` file produced with `line.profiling=TRUE`. By default, this is the first 100 seconds. (PR#15288)
- `lsfit()` produced an incorrect error message when argument `x` had more columns than rows or `x` had a different number of rows than `y`. (Spotted by Renaud Gaujoux.)
- Binary operations on equal length vectors copied the class name from the second operand when the first had no class name, but did not set the object bit. (PR#15299)
- The `trace()` method for reference generator objects failed after those objects became function definitions.
- `write.table()` did not check that factors were constructed correctly, and so caused a segment fault when writing bad ones. (PR#15300)
- The internal HTTP server no longer chokes on POST requests without body. It will also pass-through other request types for custom handlers (with the method stored in Request-Method header) instead of failing.



CHANGES IN R 3.0.0

SIGNIFICANT USER-VISIBLE CHANGES:

- Packages need to be (re-)installed under this version (3.0.0) of R.
- There is a subtle change in behaviour for numeric index values 2^{31} and larger. These never used to be legitimate and so were treated as `NA`, sometimes with a warning. They are now legal for long vectors so there is no longer a warning, and `x[2^31] <-y` will now extend the vector on a 64-bit platform and give an error on a 32-bit one.
- It is now possible for 64-bit builds to allocate amounts of memory limited only by the OS. It may be wise to use OS facilities (e.g., `ulimit` in a `bash` shell, `limit` in `csh`), to set limits on overall memory consumption of an R process, particularly in a multi-user environment. A number of packages need a limit of at least 4GB of virtual memory to load.
  64-bit Windows builds of R are by default limited in memory usage to the amount of RAM installed: this limit can be changed by command-line option '`--max-mem-size`' or setting environment variable `R_MAX_MEM_SIZE`.
- Negative numbers for colours are consistently an error: previously they were sometimes taken as transparent, sometimes mapped into the current palette and sometimes an error.

NEW FEATURES:

- `identical()` has a new argument, `ignore.environment`, used when comparing functions (with default `FALSE` as before).
- There is a new option, `options(CBoundsCheck=)`, which controls how `.C()` and `.Fortran()` pass arguments to compiled code. If true (which can be enabled by setting the environment variable `R_C_BOUNDS_CHECK` to '`yes`'), raw, integer, double and complex arguments are always copied, and checked for writing off either end of the array on return from the compiled code (when a second copy is made). This also checks individual elements of character vectors passed to `.C()`.
  This is not intended for routine use, but can be very helpful in finding segfaults in package code.
- In `layout()`, the limits on the grid size have been raised (again).
- New simple `provideDimnames()` utility function.

- Where methods for `length()` return a double value which is representable as an integer (as often happens for package **Matrix**), this is converted to an integer.
- Matrix indexing of data frames by two-column numeric indices is now supported for replacement as well as extraction.
- `setNames()` now has a default for its `object` argument, useful for a character result.
- `StructTS()` has a revised additive constant in the `loglik` component of the result: the previous definition is returned as the `loglik0` component. However, the help page has always warned of a lack of comparability of log-likelihoods for non-stationary models. (Suggested by Jouni Helske.)
- The logic in `aggregate.formula()` has been revised. It is now possible to use a formula stored in a variable; previously, it had to be given explicitly in the function call.
- `install.packages()` has a new argument `quiet` to reduce the amount of output shown.
- Setting an element of the graphics argument `lwd` to a negative or infinite value is now an error. Lines corresponding to elements with values `NA` or `NaN` are silently omitted. Previously the behaviour was device-dependent.
- Setting graphical parameters `cex`, `col`, `lty`, `lwd` and `pch` in `par()` now requires a length-one argument. Previously some silently took the first element of a longer vector, but not always when documented to do so.
- `Sys.which()` when used with inputs which would be unsafe in a shell (e.g., absolute paths containing spaces) now uses appropriate quoting.
- `as.tclObj()` has been extended to handle raw vectors. Previously, it only worked in the other direction. (Contributed by Charlie Friedemann, PR#14939.)
- New functions `cite()` and `citeNatbib()` have been added, to allow generation of in-text citations from `"bibentry"` objects. A `cite()` function may be added to `bibstyle()` environments.
- A `sort()` method has been added for `"bibentry"` objects.
- The `bibstyle()` function now defaults to setting the default bibliography style. The `getBibstyle()` function has been added to report the name of the current default style.
- `scatter.smooth()` now has an argument `lpars` to pass arguments to `lines()`.
- `pairs()` has a new `log` argument, to allow some or all variables to be plotted on logarithmic scale. (In part, wish of PR#14919.)
- `split()` gains a `sep` argument.
- `termplot()` does a better job when given a model with interactions (and no longer attempts to plot interaction terms).
- The parser now incorporates code from Romain Francois' **parser** package, to support more detailed computation on the code, such as syntax highlighting, comment-based documentation, etc. Functions `getParseData()` and `getParseText()` access the data.
- There is a new function `rep_len()` analogous to `rep.int()` for when speed is required (and names are not).
- The undocumented use `rep(NULL,length.out = n)` for `n > 0` (which returns `NULL`) now gives a warning.
- `demo()` gains an `encoding` argument for those packages with non-ASCII demos: it defaults to the package encoding where there is one.
- `strwrap()` converts inputs with a marked encoding to the current locale: previously it made some attempt to pass through as bytes inputs invalid in the current locale.

- Specifying both `rate` and `scale` to `[dpqr]gamma` is a warning (if they are essentially the same value) or an error.
- `merge()` works in more cases where the data frames include matrices. (Wish of PR#14974.)
- `optimize()` and `uniroot()` no longer use a shared parameter object across calls. (`nlm()`, `nlminb()` and `optim()` with numerical derivatives still do, as documented.)
- The `all.equal()` method for date-times is now documented: times are regarded as equal (by default) if they differ by up to 1 msec.
- `duplicated()` and `unique()` gain a `nmax` argument which can be used to make them much more efficient when it is known that there are only a small number of unique entries. This is done automatically for factors.
- Functions `rbinom()`, `rgeom()`, `rhyper()`, `rpois()`, `rnbinom()`, `rsignrank()` and `rwilcox()` now return integer (not double) vectors. This halves the storage requirements for large simulations.
- `sort()`, `sort.int()` and `sort.list()` now use radix sorting for factors of less than 100,000 levels when `method` is not supplied. So does `order()` if called with a single factor, unless `na.last = NA`.
- `diag()` as used to generate a diagonal matrix has been re-written in C for speed and less memory usage. It now forces the result to be numeric in the case `diag(x)` since it is said to have 'zero off-diagonal entries'.
- `backsolve()` (and `forwardsolve()`) are now internal functions, for speed and support for large matrices.
- More matrix algebra functions (e.g., `chol()` and `solve()`) accept logical matrices (and coerce to numeric).
- `sample.int()` has some support for $n \geq 2^{31}$: see its help for the limitations.
  A different algorithm is used for `(n,size,replace = FALSE,prob = NULL)` for `n > 1e7` and `size <= n/2`. This is much faster and uses less memory, but does give different results.
- `approxfun()` and `splinefun()` now return a wrapper to an internal function in the **stats** namespace rather than a `.C()` or `.Call()` call. This is more likely to work if the function is saved and used in a different session.
- The functions `.C()`, `.Call()`, `.External()` and `.Fortran()` now give an error (rather than a warning) if called with a named first argument.
- `Sweave()` by default now reports the locations in the source file(s) of each chunk.
- `clearPushBack()` is now a documented interface to a long-existing internal call.
- `aspell()` gains filters for R code, Debian Control Format and message catalog files, and support for R level dictionaries. In addition, package **utils** now provides functions `aspell_package_R_files()` and `aspell_package_C_files()` for spell checking R and C level message strings in packages.
- `bibentry()` gains some support for "incomplete" entries with a '`crossref`' field.
- `gray()` and `gray.colors()` finally allow `alpha` to be specified.
- `monthplot()` gains parameters to control the look of the reference lines. (Suggestion of Ian McLeod.)
- Added support for new `%~%` relation ("is distributed as") in plotmath.
- `domain = NA` is accepted by `gettext()` and `ngettext()`, analogously to `stop()` etc.
- `termplot()` gains a new argument `plot = FALSE` which returns information to allow the plots to be modified for use as part of other plots, but does not plot them. (Contributed by Terry Therneau, PR#15076.)

- `quartz.save()`, formerly an undocumented part of `R.app`, is now available to copy a device to a `quartz()` device. `dev.copy2pdf()` optionally does this for PDF output: `quartz.save()` defaults to PNG.
- The default method of `pairs()` now allows `text.panel = NULL` and the use of `<foo>.panel = NULL` is now documented.
- `setRefClass()` and `getRefClass()` now return class generator functions, similar to `setClass()`, but still with the reference fields and methods as before (suggestion of Romain Francois).
- New functions `bitwNot()`, `bitwAnd()`, `bitwOr()` and `bitwXor()`, using the internal interfaces previously used for classes `"octmode"` and `"hexmode"`.
  Also `bitwShiftL()` and `bitwShiftR()` for shifting bits in elements of integer vectors.
- New option `"deparse.cutoff"` to control the deparsing of language objects such as calls and formulae when printing. (Suggested by a comment of Sarah Goslee.)
- `colors()` gains an argument `distinct`.
- New `demo(colors)` and `demo(hclColors)`, with utility functions.
- `list.files()` (aka `dir()`) gains a new optional argument `no..` which allows to exclude `"."` and `".."` from listings.
- Multiple time series are also of class `"matrix"`; consequently, `head()`, e.g., is more useful.
- `encodeString()` preserves UTF-8 marked encodings. Thus if factor levels are marked as UTF-8 an attempt is made to print them in UTF-8 in `RGui` on Windows.
- `readLines()` and `scan()` (and hence `read.table()`) in a UTF-8 locale now discard a UTF-8 byte-order-mark (BOM). Such BOMs are allowed but not recommended by the Unicode Standard: however Microsoft applications can produce them and so they are sometimes found on websites.
  The encoding name `"UTF-8-BOM"` for a connection will ensure that a UTF-8 BOM is discarded.
- `mapply(FUN,a1,..)` now also works when `a1` (or a further such argument) needs a `length()` method (which the documented arguments never do). (Requested by Hervé Pagès; with a patch.)
- `.onDetach()` is supported as an alternative to `.Last.lib`. Unlike `.Last.lib`, this does not need to be exported from the package's namespace.
- The `srcfile` argument to `parse()` may now be a character string, to be used in error messages.
- The `format()` method for `ftable` objects gains a `method` argument, propagated to `write.ftable()` and `print()`, allowing more compact output, notably for LaTeX formatting, thanks to Marius Hofert.
- The `utils::process.events()` function has been added to trigger immediate event handling.
- `Sys.which()` now returns `NA` (not `""`) for `NA` inputs (related to PR#15147).
- The `print()` method for class `"htest"` gives fewer trailing spaces (wish of PR#15124).
  Also print output from `HoltWinters()`, `nls()` and others.
- `loadNamespace()` allows a version specification to be given, and this is used to check version specifications given in the '`Imports`' field when a namespace is loaded.
- `setClass()` has a new argument, `slots`, clearer and less ambiguous than `representation`. It is recommended for future code, but should be back-compatible. At the same time, the allowed slot specification is slightly more general. See the documentation for details.

- `mget()` now has a default for `envir` (the frame from which it is called), for consistency with `get()` and `assign()`.
- `close()` now returns an integer status where available, invisibly. (Wish of PR#15088.)
- The internal method of `tar()` can now store paths too long for the '`ustar`' format, using the (widely supported) GNU extension. It can also store long link names, but these are much less widely supported. There is support for larger files, up to the '`ustar`' limit of 8GB.
- Local reference classes have been added to package **methods**. These are a technique for avoiding unneeded copying of large components of objects while retaining standard R functional behavior. See `?LocalReferenceClasses`.
- `untar()` has a new argument `restore_times` which if false (not the default) discards the times in the tarball. This is useful if they are incorrect (some tarballs submitted to CRAN have times in a local time zone or many years in the past even though the standard required them to be in UTC).
- `replayplot()` cannot (and will not attempt to) replay plots recorded under R ¡ 3.0.0. It may crash the R session if an attempt is made to replay plots created in a different build of R ¿= 3.0.0.
- Palette changes get recorded on the display list, so replaying plots (including when resizing screen devices and using `dev.copy()`) will work better when the palette is changed during a plot.
- `chol(pivot = TRUE)` now defaults to LAPACK, not LINPACK.
- The `parse()` function has a new parameter `keep.source`, which defaults to `options("keep.source")`.
- Profiling *via* `Rprof()` now optionally records information at the statement level, not just the function level.
- The `Rprof()` function now quotes function names in in its output file on Windows, to be consistent with the quoting in Unix.
- Profiling *via* `Rprof()` now optionally records information about time spent in GC.
- The HTML help page for a package now displays non-vignette documentation files in a more accessible format.
- To support `options(stringsAsFactors = FALSE)`, `model.frame()`, `model.matrix()` and `replications()` now automatically convert character vectors to factors without a warning.
- The `print` method for objects of class `"table"` now detects tables with 0-extents and prints the results as, e.g., '`< table of extent 0 x 1 x 2 >`'. (Wish of PR#15198.)
- Deparsing involving calls to anonymous functions has been made closer to reversible by the addition of extra parentheses.
- The function `utils::packageName()` has been added as a lightweight version of `methods::getPackageName()`.
- `find.package(lib.loc = NULL)` now treats loaded namespaces preferentially in the same way as attached packages have been for a long time.
- In Windows, the Change Directory dialog now defaults to the current working directory, rather than to the last directory chosen in that dialog.
- `available.packages()` gains a `"license/restricts_use"` filter which retains only packages for which installation can proceed solely based on packages which are guaranteed not to restrict use.
- New `check_packages_in_dir()` function in package **tools** for conveniently checking source packages along with their reverse dependencies.

- R's completion mechanism has been improved to handle help requests (starting with a question mark). In particular, help prefixes are now supported, as well as quoted help topics. To support this, completion inside quotes are now handled by R by default on all platforms.
- The memory manager now allows the strategy used to balance garbage collection and memory growth to be controlled by setting the environment variable `R_GC_MEM_GROW`. See `?Memory` for more details.
- ('For experts only', as the introductory manual says.) The use of environment variables `R_NSIZE` and `R_VSIZE` to control the initial (= minimum) garbage collection trigger for number of cons cels and size of heap has been restored: they can be overridden by the command-line options `--min-nsize` and `--min-vsize`; see `?Memory`.
- On Windows, the device name for bitmap devices as reported by `.Device` and `.Devices` no longer includes the file name. This is for consistency with other platforms and was requested by the **lattice** maintainer.
  `win.metafile()` still uses the file name: the exact form is used by package **tkrplot**.
- `set.seed(NULL)` re-initializes `.Random.seed` as done at the beginning of the session if not already set. (Suggestion of Bill Dunlap.)
- The `breaks` argument in `hist.default()` can now be a function that returns the breakpoints to be used (previously it could only return the suggested number of breakpoints).
- File '`share/licenses/licenses.db`' has some clarifications, especially as to which variants of 'BSD' and 'MIT' is intended and how to apply them to packages. The problematic licence 'Artistic-1.0' has been removed.

LONG VECTORS: This section applies only to 64-bit platforms.

- There is support for vectors longer than $2^{31}-1$ elements. This applies to raw, logical, integer, double, complex and character vectors, as well as lists. (Elements of character vectors remain limited to $2^{31}-1$ bytes.)
- Most operations which can sensibly be done with long vectors work: others may return the error 'long vectors not supported yet'. Most of these are because they explicitly work with integer indices (e.g., `anyDuplicated()` and `match()`) or because other limits (e.g., of character strings or matrix dimensions) would be exceeded or the operations would be extremely slow.
- `length()` returns a double for long vectors, and lengths can be set to 2^{31} or more by the replacement function with a double value.
- Most aspects of indexing are available. Generally double-valued indices can be used to access elements beyond $2^{31}-1$.
- There is some support for matrices and arrays with each dimension less than 2^{31} but total number of elements more than that. Only some aspects of matrix algebra work for such matrices, often taking a very long time. In other cases the underlying Fortran code has an unstated restriction (as was found for complex `svd()`).
- `dist()` can produce dissimilarity objects for more than 65536 rows (but for example `hclust()` cannot process such objects).
- `serialize()` to a raw vector is unlimited in size (except by resources).
- The C-level function `R_alloc` can now allocate 2^{35} or more bytes.
- `agrep()` and `grep()` will return double vectors of indices for long vector inputs.
- Many calls to `.C()` have been replaced by `.Call()` to allow long vectors to be supported (now or in the future). Regrettably several packages had copied the non-API `.C()` calls and so failed.

- `.C()` and `.Fortran()` do not accept long vector inputs. This is a precaution as it is very unlikely that existing code will have been written to handle long vectors (and the R wrappers often assume that `length(x)` is an integer).
- Most of the methods for `sort()` work for long vectors.
  `rank()`, `sort.list()` and `order()` support long vectors (slowly except for radix sorting).
- `sample()` can do uniform sampling from a long vector.

PERFORMANCE IMPROVEMENTS:

- More use has been made of R objects representing registered entry points, which is more efficient as the address is provided by the loader once only when the package is loaded.
  This has been done for packages `base`, `methods`, `splines` and `tcltk`: it was already in place for the other standard packages.
  Since these entry points are always accessed by the R entry points they do not need to be in the load table which can be substantially smaller and hence searched faster.
  This does mean that `.C` / `.Fortran` / `.Call` calls copied from earlier versions of R may no longer work – but they were never part of the API.
- Many `.Call()` calls in package **base** have been migrated to `.Internal()` calls.
- `solve()` makes fewer copies, especially when `b` is a vector rather than a matrix.
- `eigen()` makes fewer copies if the input has dimnames.
- Most of the linear algebra functions make fewer copies when the input(s) are not double (e.g., integer or logical).
- A foreign function call (`.C()` etc) in a package without a `PACKAGE` argument will only look in the first DLL specified in the '`NAMESPACE`' file of the package rather than searching all loaded DLLs. A few packages needed `PACKAGE` arguments added.
- The `@<-` operator is now implemented as a primitive, which should reduce some copying of objects when used. Note that the operator object must now be in package **base**: do not try to import it explicitly from package **methods**.

PACKAGE INSTALLATION:

- The transitional support for installing packages without namespaces (required since R 2.14.0) has been removed. `R CMD build` will still add a namespace, but a `.First.lib()` function will need to be converted.
  `R CMD INSTALL` no longer adds a namespace (so installation will fail), and a `.First.lib()` function in a package will be ignored (with an installation warning for now).
  As an exception, packages without a '`R`' directory and no '`NAMESPACE`' file can still be installed.
- Packages can specify in their '`DESCRIPTION file`' a line like

  ```
  Biarch: yes
  ```

  to be installed on Windows with '`--force-biarch`'.
- Package vignettes can now be processed by other engines besides `Sweave`; see 'Writing R Extensions' and the `tools::vignetteEngine` help topic for details.
- The '`*.R`' tangled source code for vignettes is now included in tarballs when `R CMD build` is used to produce them. In R 3.0.0, '`*.R`' files not in the sources will be produced at install time, but eventually this will be dropped.
- The package type `"mac.binary"` now looks in a path in the repository without any Mac subtype (which used to be '`universal`' or '`leopard`'): it looks in '`bin/macosx/contrib/3.0`' rather than '`bin/macosx/leopard/contrib/2.15`'). This is the type used for the CRAN binary distribution for OS X as from R 3.0.0.

- File '`etc/Makeconf`' makes more use of the macros `$(CC)`, `$(CXX)`, `$(F77)` and `$(FC)`, so the compiler in use can be changed by setting just these (and if necessary the corresponding flags and `FLIBS`) in file '`~/.R/Makevars`'.
  This is convenient for those working with binary distributions of R, e.g. on OS X.

UTILITIES:

- `R CMD check` now gives a warning rather than a note if it finds calls to `abort`, `assert` or `exit` in compiled code, and has been able to find the '`.o`' file in which the calls occur.
  Such calls can terminate the R process which loads the package.
- The location of the build and check environment files can now be specified by the environment variables `R_BUILD_ENVIRON` and `R_CHECK_ENVIRON`, respectively.
- `R CMD Sweave` gains a '`--compact`' option to control possibly reducing the size of the PDF file it creates when '`--pdf`' is given.
- `R CMD build` now omits Eclipse's '`.metadata`' directories, and `R CMD check` warns if it finds them.
- `R CMD check` now does some checks on functions defined within reference classes, including of `.Call()` etc calls.
- `R CMD check --as-cran` notes assignments to the global environment, calls to `data()` which load into the global environment, and calls to `attach()`.
- `R CMD build` by default uses the internal method of `tar()` to prepare the tarball. This is more likely to produce a tarball compatible with `R CMD INSTALL` and `R CMD check`: an external `tar` program, including options, can be specified *via* the environment variable `R_BUILD_TAR`.
- `tools::massageExamples()` is better protected against packages which re-define base functions such as `cat()` and `get()` and so can cause `R CMD check` to fail when checking examples.
- `R CMD javareconf` has been enhanced to be more similar to the code used by `configure`.
  There is now a test that a JNI program can be compiled (like `configure` did) and only working settings are used.
  It makes use of custom settings from configuration recorded in '`etc/javaconf`'.
- The '`--no-vignettes`' argument of `R CMD build` has been renamed to the more accurate '`--no-build-vignettes`': its action has always been to (re)build vignettes and never omitted them.
  `R CMD check` accepts '`--no-build-vignettes`' as a preferred synonym for '`--no-rebuild-vignettes`'.

DEPRECATED AND DEFUNCT:

- The `ENCODING` argument to `.C()` is defunct. Use `iconv()` instead.
- The `.Internal(eval.with.vis)` non-API function has been removed.
- Support for the converters for use with `.C()` has been removed, including the oft misused non-API header '`R_ext/RConverters.h`'.
- The previously deprecated uses of `array()` with a 0-length `dim` argument and `tapply()` with a 0-length `INDEX` list are now errors.
- '`Translation`' packages are defunct.
- Calling `rep()` or `rep.int()` on a pairlist or other non-vector object is now an error.
- Several non-API entry points have been transferred to packages (e.g., `R_zeroin2`) or replaced by different non-API entry points (e.g., `R_tabulate`).

- The 'internal' graphics device invoked by `.Call("R_GD_nullDevice",package = "grDevices")` has been removed: use `pdf(file = NULL)` instead.
- The `.Fortran()` entry point `"dqrls"` which has not been used by R since version 2.15.1 is no longer available.
- Functions `traceOn()` and `traceOff()` in package **methods** are now defunct.
- Function `CRAN.packages()` is finally defunct.
- Use of `col2rgb(0)` is defunct: use `par("bg")` or `NA` instead.
- The long-defunct functions `Rd_parse()`, `anovalist.lm()`, `categpry()`, `clearNames()`, `gammaCody()`, `glm.fit.null()`, `lm.fit.null()`, `lm.wfit.null()`, `manglePackageNames()`, `mauchley.test()`, `package.contents()`, `print.coefmat()`, `reshapeLong()`, `reshapeWide()`, `tkclose()`, `tkcmd()`, `tkfile.dir()`, `tkfile.tail()`, `tkopen()`, `tkputs()`, `tkread()`, `trySilent()` and `zip.file.extract()` have been removed entirely (but are still documented in the help system).
- The unused `dataPath` argument to `attachNamespace()` has been removed.
- `grid.prompt()` has been removed: use `devAskNewPage()` instead.
- The long-deprecated `intensities` component is no longer returned by `hist()`.
- `mean()` for data frames and `sd()` for data frames and matrices are defunct.
- `chol(pivot = FALSE,LINPACK = TRUE)`, `ch2inv(LINPACK = TRUE)`, `eigen(EISPACK = TRUE)`, `solve(LINPACK = TRUE)` and `svd(LINPACK = TRUE)` are defunct: LAPACK will be used, with a warning.
- The `keep.source` argument to `library()` and `require()` is defunct. This option needs to be set at install time.
- Documentation for `real()`, `as.real()` and `is.real()` has been moved to 'defunct' and the functions removed.
- The `maxRasters` argument of `pdf()` (unused since R 2.14.0) has been removed.
- The unused `fontsmooth` argument has been removed from the `quartz()` device.
- All the (non-API) EISPACK entry points in R have been removed.
- `chol(pivot = TRUE,LINPACK = TRUE)` is deprecated.
- The long-deprecated use of `\synopsis` in the '`Usage`' section of '`.Rd`' files will be removed in R 3.1.0.
- `.find.package()` and `.path.package()` are deprecated: only the public versions without the dot have ever been in the API.
- In a package's '`DESCRIPTION`' file,

  ```
  License: X11
  ```

  is deprecated, since it includes 'Copyright (C) 1996 X Consortium' which cannot be appropriate for a current R package. Use 'MIT' or 'BSD_2_clause' instead.

CODE MIGRATION:

- The C code underlying base graphics has been migrated to the **graphics** package (and hence no longer uses `.Internal()` calls).
- Most of the `.Internal()` calls used in the **stats** package have been migrated to C code in that package.
  This means that a number of `.Internal()` calls which have been used by packages no longer exist, including `.Internal(cor)` `.Internal(cov)`, `.Internal(optimhess)` and `.Internal(update.formula)`.
- Some `.External()` calls to the `base` package (really to the R executable or shared library) have been moved to more appropriate packages. Packages should not have been using such calls, but some did (mainly those used by `integrate()`).

PACKAGE parallel:

- There is a new function `mcaffinity()` which allows getting or setting the CPU affinity mask for the current R process on systems that supports this (currently only Linux has been tested successfully). It has no effect on systems which do not support process affinity. Users are not expected to use this function directly (with the exception of fixing libraries that break affinity settings like OpenBLAS) – the function is rather intended to support affinity control in high-level parallel functions. In the future, R may supplement lack of affinity control in the OS by its own bookkeeping *via* `mcaffinity()` related to processes and threads it spawns.
- `mcparallel()` has a new argument `mc.affinity` which attempts to set the affinity of the child process according to the specification contained therein.
- The port used by socket clusters is chosen randomly: this should help to avoid clashes observed when two users of a multi-user machine try to create a cluster at the same time. To reproduce the previous behaviour set environment variable `R_PARALLEL_PORT` to `10187`.

C-LEVEL FACILITIES:

- There has been some minor re-organization of the non-API header files. In particular, '`Rinternals.h`' no longer includes the non-API header '`R_exts/PrtUtil.h`', and that no longer includes '`R_exts/Print.h`'.
- Passing `NULL` to `.C()` is now an error.
- `.C()` and `.Fortran()` now warn if `"single"` arguments are used with `DUP = FALSE`, as changes to such arguments are not returned to the caller.
- C entry points `R_qsort` and `R_qsort_I` now have `start` and `end` as `size_t` to allow them to work with longer vectors on 64-bit platforms. Code using them should be recompiled.
- A few recently added C entry points were missing the remapping to `Rf_`, notably `[dpq]nbinom_mu`.
- Some of the interface pointers formerly available only to `R.app` are now available to front-ends on all Unix-alikes: one has been added for the interface to `View()`.
- `PACKAGE = ""` is now an error in `.C()` etc calls: it was always contrary to the documentation.
- Entry point `rcont2` has been migrated to package **stats** and so is no longer available.
- `R_SVN_REVISION` in '`Rversion.h`' is now an integer (rather than a string) and hence usable as e.g. `#if R_SVN_REVISION < 70000`.
- The entry points `rgb2hsv` and `hsv2rgb` have been migrated to package **grDevices** and so are no longer available.
- `R_GE_version` has been increased to `10` and `name2col` removed (use `R_GE_str2col` instead). R internal colour codes are now defined using the typedef `rcolor`.
- The `REPROTECT` macro now checks that the protect index is valid.
- Several non-API entry points no longer used by R have been removed, including the Fortran entry points `chol`, `chol2inv`, `cg`, `ch` and `rg`, and the C entry points `Brent_fmin`, `fft_factor` and `fft_work`.
- If a `.External` call is registered with a number of arguments (other than `-1`), the number of arguments passed is checked for each call (as for other foreign function calls).
- It is now possible to write custom connection implementations outside core R using '`R_ext/Connections.h`'. Please note that the implementation of connections is still considered internal and may change in the future (see the above file for details).

INTERNATIONALIZATION:

- The management of translations has been converted to R code: see `?tools::update_pkg_po`.
- The translations for the R interpreter and `RGui.exe` are now part of the **base** package (rather than having sources in directory '`po`' and being installed to '`share/locale`'). Thus the **base** package supports three translation domains, `R-base`, `R` and `RGui`.
- The compiled translations which ship with R are all installed to the new package **translations** for easier updating. The first package of that name found on `.libPaths()` at the start of the R session will be used. (It is possible messages will be used before `.libPaths()` is set up in which case the default translations will be used: set environment variable `R_TRANSLATIONS` to point to the location of the intended **translations** package to use this right from the start.)
- The translations form a separate group in the Windows installer, so can be omitted if desired.
- The markup for many messages has been changed to make them easier to translate, incorporating suggestions from Łukasz Daniel.

INSTALLATION:

- There is again support for building without using the C 'long double' type. This is required by C99, but system implementations can be slow or flawed. Use `configure` option '`--disable-long-double`'.
- `make pdf` and `make install-pdf` now make and install the full reference index (including all base and recommended packages).
- The 'reference manual' on the Windows GUI menu and included in the installer is now the full reference index, including all base and recommended packages.
- R help pages and manuals have no ISBNs because ISBN rules no longer allow constantly changing content to be assigned an ISBN.
- The Windows installer no longer installs a Start Menu link to the static help pages; as most pages are generated dynamically, this led to a lot of broken links.
- Any custom settings for Java configuration are recorded in file '`etc/javaconf`' for subsequent use by `R CMD javareconf`.
- There is now support for `makeinfo` version 5.0 (which requires a slightly different '`.texi`' syntax).
- The minimum versions for '`--use-system-zlib`' and `--use-system-pcre` are now tested as 1.2.5 and 8.10 respectively.
- On Windows, the stack size is reduced to 16MB on 32-bit systems: misguided users were launching many threads without controlling the stack size.
- `configure` no longer looks for file '`~/.Rconfig`': '`~/.R/config`' has long been preferred.

BUG FIXES:

- When `R CMD build` is run in an encoding other than the one specified in the package's '`DESCRIPTION`' file it tries harder to expand the `authors@R` field in the specified encoding. (PR#14958)
- If `R CMD INSTALL` is required to expand the `authors@R` field of the '`DESCRIPTION`' file, it tries harder to do so in the encoding specified for the package (rather than using ASCII escapes).
- Fix in package **grid** for pushing a viewport into a layout cell, where the layout is within a viewport that has zero physical width OR where the layout has zero total relative width (likewise for height). The layout column widths (or row heights) in this case were being calculated with non-finite values. (Reported by Winston Chang.)

- `solve(A,b)` for a vector `b` gave the answer names from `colnames(A)` for `LINPACK = TRUE` but not in the default case.
- `La.svd()` accepts logical matrices (as documented, and as `svd()` did).
- `legend()` now accepts negative `pch` values, in the same way `points()` long has.
- Parse errors when installing files now correctly display the name of the file containing the bad code.
- In Windows, tcltk windows were not always properly constructed. (PR#15150)
- The internal functions implementing `parse()`, `tools::parseLatex()` and `tools::parse_Rd()` were not reentrant, leading to errors in rare circumstances such as a garbage collection triggering a recursive call.
- Field assignments in reference class objects *via* `$<-` were not being checked because the magic incantation to turn methods on for that primitive operator had been inadvertently omitted.
- `setHook(hookname,value,action="replace")` set the hook to be the value, rather than a list containing the value as documented. (PR#15167)
- If a package used a '`NEWS.Rd`' file, the main HTML package index page did not link to it. (Reported by Dirk Eddelbuettel.)
- The primitive implementation of `@<-` was not checking the class of the replacement. It now does a check, quicker but less general than `slot<-`. See the help.
- `split(x,f)` now recycles classed objects `x` in the same way as vectors. (Reported by Martin Morgan.)
- `pbeta(.28,1/2,2200,lower.tail=FALSE,log.p=TRUE)` is no longer `-Inf`; ditto for corresponding `pt()` and `pf()` calls, such as `pt(45,df=5000,lower.tail=FALSE,log.p=TRUE)`. (PR#15162)
- The Windows graphics device would crash R if a user attempted to load the graphics history from a variable that was not a saved history. (PR#15230)
- The workspace size for the `predict()` method for `loess()` could exceed the maximum integer size. (Reported by Hiroyuki Kawakatsu.)
- `ftable(x,row.vars,col.vars)` now also works when the `*.vars` arguments are (integer or character vectors) of length zero.
- Calling `cat()` on a malformed UTF-8 string could cause the Windows GUI to lock up. (PR#15227)
- `removeClass(cc)` gave "node stack overflow" for some class definitions containing `"array"` or `"matrix"`.

CHANGES in previous versions

- Older news can be found in text format in files '`NEWS.0`', '`NEWS.1`' and '`NEWS.2`' in the '`doc`' directory. News in HTML format for R versions from 2.10.0 to 2.15.3 is in '`doc/html/NEWS.2.html`'.