REFERENCES

Abelson, J., Trotta, C.R. and Li, H. (1998) tRNA splicing. J Biol Chem, 273, 12685-12688.

- Abovich, N., Legrain, P. and Rosbash, M. (1990) The yeast PRP6 gene encodes a U4/U6 small nuclear ribonucleoprotein particle (snRNP) protein, and the PRP9 gene encodes a protein required for U2 snRNP binding. *Mol Cell Biol*, **10**, 6417-6425.
- Abovich, N., Liao, X.C. and Rosbash, M. (1994) The yeast MUD2 protein: an interaction with PRP11 defines a bridge between commitment complexes and U2 snRNP addition. *Genes Dev*, **8**, 843-854.
- Abovich, N. and Rosbash, M. (1997) Cross-intron bridging and interactions in the yeast commitment complex are conserved in mammals. *Cell*, **89**, 403-412.
- Altschul, S.F., Gish, W., Miller, W., Myers, E.W. and Lipman, D.J. (1990) Basic local alignment search tool. *J Mol Biol*, **215**, 403-410.
- Ares, M., Jr. (1986) U2 RNA from yeast is unexpectedly large and contains homology to vertebrate U4, U5, and U6 small nuclear RNAs. *Cell*, **47**, 49-59.
- Ares, M., Jr., Grate, L. and Pauling, M.H. (1999) A handful of intron-containing genes produces the lion's share of yeast mRNA. *RNA*, **5**, 1138-1139.
- Arning, S., Grüter, P., Bilbe, G. and Krämer, A. (1996) Mammalian splicing factor SF1 is encoded by variant cDNAs and binds to RNA. *RNA*, **2**, 794-810.
- Avery, O.T., MacLeod, C.M. and McCarty, M. (1944) Studies on the chemical nature of the substance inducing transformation of pneumococcal types. Induction of transformation by a desoxyribonucleic acid fraction isolated from Pneumococcus type III. *Journal of Experimental Medicine*, 137-158.
- Bachenheimer, S. and Darnell, J.E. (1975) Adenovirus-2 mRNA is transcribed as part of a high-molecular-weight precursor RNA. *Proc Natl Acad Sci U S A*, **72**, 4445-4449.
- Bedford, M.T., Chan, D.C. and Leder, P. (1997) FBP WW domains and the Abl SH3 domain bind to a specific class of proline-rich ligands. *EMBO J*, **16**, 2376-2383.
- Bedford, M.T., Reed, R. and Leder, P. (1998) WW domain-mediated interactions reveal a spliceosome-associated protein that binds a third class of proline-rich motif: the proline glycine and methionine-rich motif. *Proc Natl Acad Sci USA*, **95**, 10602-10607.
- Beggs, J.D., Teigelkamp, S. and Newman, A.J. (1995) The role of PRP8 protein in nuclear pre-mRNA splicing in yeast. *J Cell Sci Suppl*, **19**, 101-105.
- Bennett, M., Michaud, S., Kingston, J. and Reed, R. (1992a) Protein components specifically associated with prespliceosome and spliceosome complexes. *Genes Dev*, **6**, 1986-2000.

- Bennett, M., Michaud, S., Kingston, J. and Reed, R. (1992b) Protein components specifically associated with prespliceosome and spliceosome complexes. *Genes Dev*, 7, 1986-2000.
- Berget, S.M., Moore, C. and Sharp, P.A. (1977) Spliced segments at the 5' terminus of adenovirus 2 late mRNA. *Proc Natl Acad Sci USA*, **74**, 3171-3175.
- Berglund, J., Chua, K., Abovich, N., Reed, R. and Rosbash, M. (1997) The splicing factor BBP interacts specifically with the pre-mRNA branch point sequence UACUAAC. *Cell*, **89**, 781-787.
- Berglund, J.A., Abovich, N. and Rosbash, M. (1998a) A cooperative interaction between U2AF65 and mBBP/SF1 facilitates branchpoint region recognition. *Genes Dev*, **12**, 858-867.
- Berglund, J.A., Fleming, M.L. and Rosbash, M. (1998b) The KH domain of the branchpoint sequence binding protein determines specificity for the pre-mRNA branchpoint sequence. *RNA*, **4**, 998-1006.
- Bindereif, A. and Green, M.R. (1987) An ordered pathway of snRNP binding during mammalian pre-mRNA splicing complex assembly. *EMBO J.*, **6**, 2415-2424.
- Birney, E., Thompson, J.D. and Gibson, T.J. (1996) PairWise and SearchWise: finding the optimal alignment in a simultaneous comparison of a protein profile against all DNA translation frames. *Nucleic Acids Res*, **24**, 2730-2739.
- Black, D.L. (1995) Finding splice sites within a wilderness of RNA. RNA, 1, 763-771.
- Boeck, R., Lapeyre, B., Brown, C.E. and Sachs, A.B. (1998) Capped mRNA degradation intermediates accumulate in the yeast spb8-2 mutant. *Mol Cell Biol*, **18**, 5062-5072.
- Botstein, D., Falco, S.C., Stewart, S.E., Brennan, M., Scherer, S., Stinchcomb, D.T., Struhl, K. and Davis, R.W. (1979) Sterile host yeasts (SHY): a eukaryotic system of biological containment for recombinant DNA experiments. *Gene*, 8, 17-24.
- Bouveret, E., Rigaut, G., Shevchenko, A., Wilm, M. and Séraphin, B. (2000) A Sm-like protein complex that participates in mRNA degradation. *EMBO J*, in press.
- Breathnach, R., Benoist, C., O'Hare, K., Gannon, F. and Chambon, P. (1978) Ovalbumin gene: evidence for a leader sequence in mRNA and DNA sequences at the exon-intron boundaries. *Proc Natl Acad Sci U S A*, **75**, 4853-4857.
- Breathnach, R., Mandel, J.L. and Chambon, P. (1977) Ovalbumin gene is split in chicken DNA. *Nature*, **270**, 314-319.
- Brenner, S., Jacob, F. and Meselson, M. (1961) An unstable intermediate carrying information from genes to ribosomes for protein synthesis. *Nature*, **190**, 576-581.
- Brody, E. and Abelson, J. (1985) The "spliceosome": yeast pre-messenger RNA associates with a 40S complex in a splicing-dependent reaction. *Science*, **228**, 963-967.

- Burge, C., Tuschl, T. and Sharp, P. (1998a) Splicing of precursors to mRNA by the spliceosome. In Gesteland, R., Cech, T. and Atkins, J. (eds.), *The RNA World, Second Edition*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, pp. 525-560.
- Burge, C.B., Padgett, R.A. and Sharp, P.A. (1998b) Evolutionary fates and origins of U12type introns. *Mol Cell*, **2**, 773-785.
- Burtis, K.C. (1993) The regulation of sex determination and sexually dimorphic differentiation in Drosophila. *Curr Opin Cell Biol*, **5**, 1006-1014.
- Cadwell, R.C. and Joyce, G.F. (1992) Randomization of genes by PCR mutagenesis. *PCR Methods Appl*, **2**, 28-33.
- Camasses, A., Bragado-Nilsson, E., Martin, R., Séraphin, B. and Bordonne, R. (1998) Interactions within the yeast Sm core complex: from proteins to amino acids. *Mol Cell Biol*, **18**, 1956-1966.
- Caslini, C., Spinelli, O., Cazzaniga, G., Golay, J., De, G.L., Pedretti, A., Breviario, F., Amaru, R., Barbui, T., Biondi, A., Introna, M. and Rambaldi, A. (1997) Identification of two novel isoforms of the ZNF162 gene: a growing family of signal transduction and activator of RNA proteins. *Genomics*, **42**, 268-277.
- Caspary, F. and Séraphin, B. (1998) The yeast U2A'/U2B" complex is required for prespliceosome formation. *EMBO J.*, **17**, 6348-6358.
- Caspary, F., Shevchenko, A., Wilm, M. and Séraphin, B. (1999) Partial purification of the yeast U2 snRNP reveals a novel yeast pre- mRNA splicing factor required for pre-spliceosome assembly. *EMBO J*, **18**, 3463-3474.
- Cate, J.H., Gooding, A.R., Podell, E., Zhou, K., Golden, B.L., Kundrot, C.E., Cech, T.R. and Doudna, J.A. (1996) Crystal structure of a group I ribozyme domain: principles of RNA packing. *Science*, 273, 1678-1685.
- Cech, T. (1986) The generality of self splicing RNA: relationship to nuclear mRNA splicing. *Cell*, 44, 207-210.
- Cech, T. (1993) Structure and mechanism of the large catalyc RNAs: Group I and Group II introns and ribonuclease P. In Gesteland, R. and Atkins, J. (eds.), *The RNA world*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, pp. 239 - 269.
- Champion-Arnaud, P. and Reed, R. (1994) The prespliceosome components SAP 49 and SAP 145 interact in a complex implicated in tethering U2 snRNP to the branch site. *Genes Dev*, **16**, 1974-1983.
- Chen, S., Anderson, K. and Moore, M.J. (2000) Evidence for a linear search in bimolecular 3' splice site AG selection. *Proc Natl Acad Sci U S A*, **97**, 593-598.
- Cheng, S.C. and Abelson, J. (1987) Spliceosome assembly in yeast. *Genes Dev*, **1**, 1014-1027.

- Cheng, S.C., Newman, A.N., Lin, R.J., McFarland, G.D. and Abelson, J.N. (1990) Preparation and fractionation of yeast splicing extract. *Methods Enzymol*, **181**, 89-96.
- Chiara, M., Palandjian, L., Krämer, R. and Reed, R. (1997) Evidence that U5 snRNP recognizes the 3' splice site for catalytic step II in mammals. *EMBO J*, **16**, 4746-4759.
- Chiara, M.D., Gozani, O., Bennett, M., Champion, A.P., Palandjian, L. and Reed, R. (1996) Identification of proteins that interact with exon sequences, splice sites, and the branchpoint sequence during each stage of spliceosome assembly. *Mol Cell Biol*, 16, 3317-3326.
- Chow, L.T., Roberts, J.M., Lewis, J.B. and Broker, T.R. (1977) A map of cytoplasmic RNA transcripts from lytic adenovirus type 2, determined by electron microscopy of RNA:DNA hybrids. *Cell*, **11**, 819-836.
- Chua, K. and Reed, R. (1999) The RNA splicing factor hSlu7 is required for correct 3' splice-site choice. *Nature*, **402**, 207-210.
- Colot, H.V., Stutz, F. and Rosbash, M. (1996) The yeast splicing factor Mud13p is a commitment complex component and corresponds to CBP20, the small subunit of the nuclear cap-binding complex. *Genes Dev*, **10**, 1699-1708.
- Cooper, M., Johnston, L.H. and Beggs, J.D. (1995) Identification and characterization of Uss1p (Sdb23p): a novel U6 snRNA-associated protein with significant similarity to core proteins of small nuclear ribonucleoproteins. *EMBO J*, 14, 2066-2075.
- Copertino, D.W. and Hallick, R.B. (1991) Group II twintron: an intron within an intron in a chloroplast cytochrome b-559 gene. *EMBO J*, **10**, 433-442.
- Cox, S. and Walter, P. (1996) A novel mechanism for regulating activity of a transcription factor that controls the unfolded protein response. *Cell*, **87**, 391-404.
- Crick, F. (1970) Central dogma of molecular biology. Nature, 227, 561-563.
- Crick, F. (1979) Split genes and RNA splicing. Science, 204, 264-271.
- Crispino, J.D., Blencowe, B.J. and Sharp, P.A. (1994) Complementation by SR proteins of pre-mRNA splicing reactions depleted of U1 snRNP. *Science*, **265**, 1866-1869.
- Crispino, J.D. and Sharp, P.A. (1995) A U6 snRNA:pre-mRNA interaction can be ratelimiting for U1-independent splicing. *Genes Dev*, **9**, 2314-2323.
- Czaplinski, K., Ruiz-Echevarria, M.J., Gonzalez, C.I. and Peltz, S.W. (1999) Should we kill the messenger? The role of the surveillance complex in translation termination and mRNA turnover. *Bioessays*, **21**, 685-696.
- Das, B.K., Xia, L., Palandjian, L., Gozani, O., Chyung, Y. and Reed, R. (1999) Characterization of a Protein Complex Containing Spliceosomal Proteins SAPs 49, 130, 145, and 155. *Mol Cell Biol*, **19**, 6796-6802.

- Datta, B. and Weiner, A.M. (1991) Genetic evidence for base pairing between U2 and U6 snRNA in mammalian mRNA splicing. *Nature*, **352**, 821-824.
- de Souza, S.J., Long, M., Schoenbach, L., Roy, S.W. and Gilbert, W. (1996) Intron positions correlate with module boundaries in ancient proteins. *Proc Natl Acad Sci U S A*, **93**, 14632-14636.
- Deshler, J.O. and Rossi, J.J. (1991) Unexpected point mutations activate cryptic 3' splice sites by perturbing a natural secondary structure within a yeast intron. *Genes Dev*, **5**, 1252-1263.
- Devereux, J., Haeberli, P. and Smithies, O. (1984) A comprehensive set of sequence analysis programs for the VAX. *Nucleic Acids Res*, **12**, 387-395.
- Doetsch, N.A., Thompson, M.D. and Hallick, R.B. (1998) A maturase-encoding group III twintron is conserved in deeply rooted euglenoid species: are group III introns the chicken or the egg? *Mol Biol Evol*, **15**, 76-86.
- Engebrecht, J., Voelkel-Meiman, K. and Roeder, G. (1991) Meiosis-specific RNA splicing in yeast. *Cell*, **66**, 1257-1268.
- Fabrizio, P., Laggerbauer, B., Lauber, J., Lane, W.S. and Lührmann, R. (1997) An evolutionarily conserved U5 snRNP-specific protein is a GTP-binding factor closely related to the ribosomal translocase EF-2. *EMBO J*, **16**, 4092-4106.
- Fabrizio, P., McPheeters, D.S. and Abelson, J. (1989) In vitro assembly of yeast U6 snRNP: a functional assay. *Genes Dev*, **3**, 2137-2150.
- Fischer, U., Liu, Q. and Dreyfuss, G. (1997) The SMN-SIP1 complex has an essential role in spliceosomal snRNP biogenesis. *Cell*, **90**, 1023-1029.
- Fleckner, J., Zhang, M., Valcárcel, J. and Green, M.R. (1997) U2AF65 recruits a novel human DEAD box protein required for the U2 snRNP-branchpoint interaction. *Genes Dev*, **11**, 1864-1872.
- Fortes, P., Bilbao-Cortes, D., Fornerod, M., Rigaut, G., Raymond, W., Séraphin, B. and Mattaj, I.W. (1999) Luc7p, a novel yeast U1 snRNP protein with a role in 5' splice site recognition. *Genes Dev*, 13, 2425-2438.
- Foti, D.M., Welihinda, A., Kaufman, R.J. and Lee, A.S. (1999) Conservation and divergence of the yeast and mammalian unfolded protein response. Activation of specific mammalian endoplasmic reticulum stress element of the grp78/BiP promoter by yeast Hac1. *J Biol Chem*, **274**, 30402-30409.
- Frendewey, D. and Keller, W. (1985) Stepwise assembly of a pre-mRNA splicing complex requires U-snRNPs and specific intron sequences. *Cell*, **42**, 355-367.
- Fromont-Racine, M., Rain, J.-C. and Legrain, P. (1997) Toward a functional analysis of the yeast genome through exhaustive two-hybrid screens,. *Nature Genet*, **16**, 277-282.

Fu, X. (1995) The superfamily of arginine/serine-rich splicing factors. RNA, 1, 663-680.

- Fu, X.D. and Maniatis, T. (1992) The 35-kDa mammalian splicing factor SC35 mediates specific interactions between U1 and U2 small nuclear ribonucleoprotein particles at the 3' splice site. *Proc Natl Acad Sci U S A*, **89**, 1725-1729.
- Gilbert, W. (1978) Why genes in pieces? *Nature*, **271**, 501.
- Gilbert, W. and Glynias, M. (1993) On the ancient nature of introns. Gene, 135, 137-144.
- Giroux, M.J., Clancy, M., Baier, J., Ingham, L., McCarty, D. and Hannah, L.C. (1994) De novo synthesis of an intron by the maize transposable element Dissociation. *Proc Natl Acad Sci USA*, **91**, 12150-12154.
- Goffeau, A., Barrell, B., Bussey, H., Davies, R., Dujon, B., Feldman, H., Galibert, F., Hoheisel, J., Jacq, C., Johnston, M., Louis, E., Mewes, H., Murakami, Y., Philippsen, P., Tettelin, H. and Oliver, S. (1996) Life with 6.000 genes. *Science*, 274, 546-567.
- Golden, B.L., Gooding, A.R., Podell, E.R. and Cech, T.R. (1998) A preorganized active site in the crystal structure of the Tetrahymena ribozyme. *Science*, **282**, 259-264.
- Gonzalez, T.N., Sidrauski, C., Dorfler, S. and Walter, P. (1999) Mechanism of nonspliceosomal mRNA splicing in the unfolded protein response pathway. *EMBO J*, **18**, 3119-3132.
- Gozani, O., Potashkin, J. and Reed, R. (1998) A potential role for U2AF-SAP 155 interactions in recruiting U2 snRNP to the branch site. *Mol Cell Biol*, **18**, 4752-4760.
- Grabowski, P.J., Padgett, R.A. and Sharp, P.A. (1984) Messenger RNA splicing in vitro: an excised intervening sequence and a potential intermediate. *Cell*, **37**, 415-427.
- Grabowski, P.J., Seiler, S.R. and Sharp, P.A. (1985) A multicomponent complex is involved in the splicing of messenger RNA precursors. *Cell*, **42**, 345-353.
- Gunderson, S.I., Vagner, S., Polycarpou-Schwarz, M. and Mattaj, I.W. (1997) Involvement of the carboxyl terminus of vertebrate poly(A) polymerase in U1A autoregulation and in the coupling of splicing and polyadenylation. *Genes Dev*, **11**, 761-773.
- Guthrie, C. and Fink, G. (1991) *Guide to yeast genetics and molecular biology*. Academic Press, Inc., San Diego, California.
- Guthrie, C. and Patterson, B. (1988) Spliceosomal snRNAs. Annu Rev Genet, 22, 387-419.
- Hall, S. and Padgett, R. (1994) Conserved sequences in a class of rare eukaryotic nuclear introns with non-consensus splice sites. *J Mol Biol*, **239**, 357-365.
- Hall, S. and Padgett, R. (1996) Requirement of U12 snRNA for in vivo splicing of a minor class of eukaryotic nuclear pre-mRNA introns. *Science*, **271**, 1716-1718.
- Hamm, J., Darzynkiewicz, E., Tahara, S.M. and Mattaj, I.W. (1990) The trimethylguanosine cap structure of U1 snRNA is a component of a bipartite nuclear targeting signal. *Cell*, **62**, 569-577.

- Hartmuth, K., Raker, V.A., Huber, J., Branlant, C. and Lührmann, R. (1999) An unusual chemical reactivity of Sm site adenosines strongly correlates with proper assembly of core U snRNP particles. *J Mol Biol*, **285**, 133-147.
- Hartwell, L.H. (1967) Macromolecule synthesis in temperature-sensitive mutants of yeast. *J Bacteriol*, **93**, 1662-1670.
- He, F., Peltz, S.W., Donahue, J.L., Rosbash, M. and Jacobson, A. (1993) Stabilization and ribosome association of unspliced pre-mRNAs in a yeast upf1- mutant. *Proc Natl Acad Sci U S A*, **90**, 7034-7038.
- Hernandez, N. (1985) Formation of the 3' end of U1 snRNA is directed by a conserved sequence located downstream of the coding region. *EMBO J*, **4**, 1827-1837.
- Hernandez, N. and Keller, W. (1983) Splicing of in vitro synthesized messenger RNA precursors in HeLa cell extracts. *Cell*, **35**, 89-99.
- Hetzer, M. and Mattaj, I.W. (2000) An ATP-dependent, ran-independent mechanism for nuclear import of the U1A and U2B" spliceosome proteins. *J Cell Biol*, **148**, 293-304.
- Hilleren, P. and Parker, R. (1999) mRNA surveillance in eukaryotes: kinetic proofreading of proper translation termination as assessed by mRNP domain organization? *RNA*, **5**, 711-719.
- Hodges, P.E., Jackson, S.P., Brown, J.D. and Beggs, J.D. (1995) Extraordinary sequence conservation of the PRP8 splicing factor. *Yeast*, **11**, 337-342.
- Huang, Q. and Pederson, T. (1999) A human U2 RNA mutant stalled in 3' end processing is impaired in nuclear import. *Nucleic Acids Res*, **27**, 1025-1031.
- Hutchison, H.T., Hartwell, L.H. and McLaughlin, C.S. (1969) Temperature-sensitive yeast mutant defective in ribonucleic acid production. *J Bacteriol*, **99**, 807-814.
- Imamoto, F. and Ito, J. (1968) Simultaneous initiation of transcription and translation at internal sites in the tryptophan operon of E. coli. *Nature*, **220**, 27-31.
- Ito, H., Fukada, Y., Murata, K. and Kimura, A. (1983) Transformation of intact yeast cells treated with alkali cations. *J Bacteriol*, **153**, 163-168.
- Izaurralde, E., Lewis, J., Gamberi, C., Jarmolowski, A., McGuigan, C. and Mattaj, I.W. (1995) A cap-binding protein complex mediating U snRNA export. *Nature*, **376**, 709-712.
- Izaurralde, E., Lewis, J., McGuigan, C., Jankowska, M., Darzynkiewicz, E. and Mattaj, I.W. (1994) A nuclear cap binding protein complex involved in pre-mRNA splicing. *Cell*, 78, 657-668.
- Jackson, I.J. (1991) A reappraisal of non-consensus mRNA splice sites. *Nucleic Acids Res*, **19**, 3795-3798.

- Jacquier, A., Rodriguez, J.R. and Rosbash, M. (1985) A quantitative analysis of the effects of 5' junction and TACTAAC box mutants and mutant combinations on yeast mRNA splicing. *Cell*, **43**, 423-430.
- Jankowsky, E., Gross, C.H., Shuman, S. and Pyle, A.M. (2000) The DExH protein NPH-II is a processive and directional motor for unwinding RNA. *Nature*, **403**, 447-451.
- Jarmolowski, A., Boelens, W.C., Izaurralde, E. and Mattaj, I.W. (1994) Nuclear export of different classes of RNA is mediated by specific factors. *J Cell Biol*, **124**, 627-635.
- Jeffreys, A.J. and Flavell, R.A. (1977) The rabbit beta-globin gene contains a large large insert in the coding sequence. *Cell*, **12**, 1097-1108.
- Kambach, C., Walke, S., Young, R., Avis, J.M., de la Fortelle, E., Raker, V.A., Lührmann, R., Li, J. and Nagai, K. (1999) Crystal structures of two Sm protein complexes and their implications for the assembly of the spliceosomal snRNPs. *Cell*, **96**, 375-387.
- Kanaar, R., Roche, S.E., Beall, E.L., Green, M.R. and Rio, D.C. (1993) The conserved premRNA splicing factor U2AF from Drosophila: requirement for viability. *Science*, 262, 569-573.
- Kandels-Lewis, S. and Séraphin, B. (1993) Involvement of U6 snRNA in 5' splice site selection. *Science*, **262**, 2035-2039.
- Kennedy, C.F., Krämer, A. and Berget, S.M. (1998) A role for SRp54 during intron bridging of small introns with pyrimidine tracts upstream of the branch point. *Mol Cell Biol*, **18**, 5425-5434.
- Kohtz, J.D., Jamison, S.F., Will, C.L., Zuo, P., Lührmann, R., Garcia Blanco, M.A. and Manley, J.L. (1994) Protein-protein interactions and 5'-splice-site recognition in mammalian mRNA precursors. *Nature*, **368**, 119-124.
- Konarska, M.M. and Sharp, P.A. (1986) Electrophoretic separation of complexes involved in the splicing of precursors to mRNAs. *Cell*, **46**, 845-855.
- Konarska, M.M. and Sharp, P.A. (1987) Interactions between small nuclear ribonucleoprotein particles in formation of spliceosomes. *Cell*, **49**, 763-774.
- Konforti, B., Koziolkiewicz, M. and Konarska, M. (1993) Disruption of base pairing between the 5' splice site and 5' end of U1 snRNA is required for spliceosome assembly. *Cell*, **75**, 863-873.
- Krainer, A.R., Maniatis, T., Ruskin, B. and Green, M.R. (1984) Normal and mutant human beta-globin pre-mRNAs are faithfully and efficiently spliced in vitro. *Cell*, **36**, 993-1005.
- Krämer, A. (1988) Presplicing complex formation requires two proteins and U2 snRNP. *Genes Dev*, **2**, 1155-1167.
- Krämer, A. (1992) Purification of splicing factor SF1, a heat stable protein that functions in the assembly of a presplicing complex. *Mol Cell Biol*, **12**, 4545-4552.

- Krämer, A. (1996) The structure and function of proteins involved in mammalian premRNA splicing. *Annu Rev Biochem*, **65**, 367-409.
- Krämer, A., Grüter, P., Groning, K. and Kastner, B. (1999) Combined biochemical and electron microscopic analyses reveal the architecture of the mammalian U2 snRNP. *J Cell Biol*, 145, 1355-1368.
- Krämer, A., Quentin, M. and Mulhauser, F. (1998) Diverse modes of alternative splicing of human splicing factor SF1 deduced from the exon-intron structure of the gene. *Gene*, **211**, 29-37.
- Krämer, A. and Utans, U. (1991) Three protein factors (SF1, SF3 and U2AF) function in pre-splicing complex formation in addition to snRNPs. *EMBO J.*, **10**, 1503-1509.
- Kreivi, J.P. and Lamond, A.I. (1996) RNA splicing: unexpected spliceosome diversity. *Curr Biol*, **6**, 802-805.
- Lafontaine, D. and Tollervey, D. (1996) One-step PCR mediated strategy for the construction of conditionally expressed and epitope tagged yeast proteins. *Nucleic Acids Res*, **24**, 3469-3471.
- Lambowitz, A.M. and Belfort, M. (1993) Introns as mobile genetic elements. *Annu Rev Biochem*, **62**, 587-622.
- Lambowitz, A.M. and Perlman, P.S. (1990) Involvement of aminoacyl-tRNA synthetases and other proteins in group I and group II intron splicing. *Trends Biochem Sci*, **15**, 440-444.
- Leeds, P., Peltz, S.W., Jacobson, A. and Culbertson, M.R. (1991) The product of the yeast UPF1 gene is required for rapid turnover of mRNAs containing a premature translational termination codon. *Genes Dev*, **5**, 2303-2314.
- Legrain, P. and Rosbash, M. (1989) Some cis- and trans-acting mutants for splicing target pre-mRNA to the cytoplasm. *Cell*, **57**, 573-583.
- Legrain, P., Séraphin, B. and Rosbash, M. (1988) Early commitment of yeast pre-mRNA to the spliceosome pathway. *Mol Cell Biol*, **8**, 3755-3760.
- Lesser, C.F. and Guthrie, C. (1993) Mutations in U6 snRNA that alter splice site specificity: implications for the active site. *Science*, **262**, 1982-1988.
- Lewis, H.A., Chen, H., Edo, C., Buckanovich, R.J., Yang, Y.Y., Musunuru, K., Zhong, R., Darnell, R.B. and Burley, S.K. (1999) Crystal structures of Nova-1 and Nova-2 Khomology RNA-binding domains. *Structure Fold Des*, 7, 191-203.
- Lewis, H.A., Musunuru, K., Jensen, K.B., Edo, C., Chen, H., Darnell, R.B. and Burley, S.K. (2000) Sequence-specific RNA binding by a Nova KH domain: implications for paraneoplastic disease and the fragile X syndrome. *Cell*, **100**, 323-332.

- Lewis, J.D., Görlich, D. and Mattaj, I.W. (1996) A yeast cap binding protein complex (yCBC) acts at an early step in pre- mRNA splicing. *Nucleic Acids Res*, **24**, 3332-3336.
- Liao, X.C., Colot, H.V., Wang, Y. and Rosbash, M. (1992) Requirements for U2 snRNP addition to yeast pre-mRNA. *Nucleic Acids Res*, **20**, 4237-4245.
- Lin, R.J., Newman, A.J., Cheng, S.C. and Abelson, J. (1985) Yeast mRNA splicing in vitro. *J Biol Chem*, **260**, 14780-14792.
- Liu, Q., Fischer, U., Wang, F. and Dreyfuss, G. (1997) The spinal muscular atrophy disease gene product, SMN, and its associated product SIP1 are in a complex with spliceosomal snRNP proteins. *Cell*, **90**, 1013-1021.
- Logsdon, J.M., Jr., Stoltzfus, A. and Doolittle, W.F. (1998) Molecular evolution: recent cases of spliceosomal intron gain? *Curr Biol*, **8**, R560-563.
- Long, R.M., Elliott, D.J., Stutz, F., Rosbash, M. and Singer, R.H. (1995) Spatial consequences of defective processing of specific yeast mRNAs revealed by fluorescent in situ hybridization. *RNA*, **1**, 1071-1078.
- Lopez, A.J. (1998) Alternative splicing of pre-mRNA: developmental consequences and mechanisms of regulation. *Annu Rev Genet*, **32**, 279-305.
- Lopez, P.J. and Séraphin, B. (1999) Genomic-scale quantitative analysis of yeast premRNA splicing: implications for splice-site recognition. *RNA*, **5**, 1135-1137.
- Lopez, P.J. and Séraphin, B. (2000) YIDB: the yeast intron DataBase. Nucleic, 28, 85-86.
- Lutz, C.S. and Alwine, J.C. (1994) Direct interaction of the U1 snRNP-A protein with the upstream efficiency element of the SV40 late polyadenylation signal. *Genes Dev*, **8**, 576-586.
- Luukkonen, B. and Séraphin, B. (1997) The role of branchpoint-3' splice site spacing and interaction between intron terminal nucleotides in 3' splice site selection in Saccharomyces cerevisiae. *EMBO J*, **16**, 779-792.
- Luukkonen, B. and Séraphin, B. (1998) Genetic interaction between U6 snRNA and the first intron nucleotide in Saccharomyces cerevisiae. *RNA*, **4**, 167-180.
- MacDougall, C., Harbison, D. and Bownes, M. (1995) The developmental consequences of alternate splicing in sex determination and differentiation in Drosophila. *Dev Biol*, **172**, 353-376.
- MacMillan, A., Query, C., Allerson, C., Chen, S., Verdine, G. and Sharp, P. (1994) Dynamic association of proteins with the pre-mRNA branch region. *Genes Dev*, **8**, 3008-3020.
- Madhani, H.D. and Guthrie, C. (1992) A novel base-pairing interaction between U2 and U6 snRNAs suggests a mechanism for the catalytic activation of the spliceosome. *Cell*, **71**, 803-817.

- Marshallsay, C. and Lührmann, R. (1994) In vitro nuclear import of snRNPs: cytosolic factors mediate m3G-cap dependence of U1 and U2 snRNP transport. *EMBO J*, **13**, 222-231.
- Masison, D.C., Blanc, A., Ribas, J.C., Carroll, K., Sonenberg, N. and Wickner, R.B. (1995) Decoying the cap- mRNA degradation system by a double-stranded RNA virus and poly(A)- mRNA surveillance by a yeast antiviral system. *Mol Cell Biol*, **15**, 2763-2771.
- Mattick, J.S. (1994) Introns: evolution and function. Curr Opin Genet Dev, 4, 823-831.
- Mayes, A.E., Verdone, L., Legrain, P. and Beggs, J.D. (1999) Characterization of Sm-like proteins in yeast and their association with U6 snRNA. *EMBO J*, **18**, 4321-4331.
- Mazroui, R., Puoti, A. and Krämer, A. (1999) Splicing factor SF1 from Drosophila and Caenorhabditis: presence of an N-terminal RS domain and requirement for viability. *RNA*, 5, 1615-1631.
- McPheeters, D.S. and Abelson, J. (1992) Mutational analysis of the yeast U2 snRNA suggests a structural similarity to the catalytic core of group I introns. *Cell*, **71**, 819-831.
- Mendel, G. (1866) Versuche über Pflanzen-Hybriden. Verhandlungen des naturforschenden Vereines, Abhandlungen, Brünn, 3-47.
- Merendino, L., Guth, S., Bilbao, D., Martinez, C. and Valcárcel, J. (1999) Inhibition of msl-2 splicing by Sex-lethal reveals interaction between U2AF35 and the 3' splice site AG. *Nature*, **402**, 838-841.
- Michaud, S. and Reed, R. (1991) An ATP-independent complex commits pre-mRNA to the mammalian spliceosome assembly pathway. *Genes Dev*, **5**, 2534-2546.
- Michel, F. and Ferat, J.L. (1995) Structure and activities of group II introns. *Annu Rev Biochem*, **64**, 435-461.
- Moore, M., Query, C. and Sharp, P. (1993) Splicing of precursors to mRNA by the spliceosome. In Gesteland, R. and Atkins, J. (eds.), *The RNA World*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, pp. 303-357.
- Moore, M.J. (1996) Gene expression. When the junk isn't junk. *Nature*, **379**, 402-403.
- Moore, M.J. (2000) Intron recognition comes of AGe. Nat Struct Biol, 7, 14-16.
- Moore, M.J. and Sharp, P.A. (1993) Evidence for two active sites in the spliceosome provided by stereochemistry of pre-mRNA splicing. *Nature*, **365**, 364-368.
- Mottram, J., Perry, K.L., Lizardi, P.M., Lührmann, R., Agabian, N. and Nelson, R.G. (1989) Isolation and sequence of four small nuclear U RNA genes of Trypanosoma brucei subsp. brucei: identification of the U2, U4, and U6 RNA analogs. *Mol Cell Biol*, 9, 1212-1223.
- Mount, S.M. (1982) A catalogue of splice junction sequences. *Nucleic Acids Res*, **10**, 459-472.

- Musco, G., Kharrat, A., Stier, G., Fraternali, F., Gibson, T.J., Nilges, M. and Pastore, A. (1997) The solution structure of the first KH domain of FMR1, the protein responsible for the fragile X syndrome. *Nat Struct Biol*, **4**, 712-716.
- Musco, G., Stier, G., Joseph, C., Castiglione Morelli, M.A., Nilges, M., Gibson, T.J. and Pastore, A. (1996) Three-dimensional structure and stability of the KH domain: molecular insights into the fragile X syndrome. *Cell*, **85**, 237-245.
- Nagai, K. (1996) RNA-protein complexes. Curr Opin Struct Biol, 6, 53-61.
- Nakagawa, T. and Ogawa, H. (1999) The Saccharomyces cerevisiae MER3 gene, encoding a novel helicase-like protein, is required for crossover control in meiosis. *EMBO J*, **18**, 5714-5723.
- Nakielny, S. and Dreyfuss, G. (1999) Transport of proteins and RNAs in and out of the nucleus. *Cell*, **99**, 677-690.
- Nasim, F.H., Spears, P.A., Hoffmann, H.M., Kuo, H.C. and Grabowski, P.J. (1990) A Sequential splicing mechanism promotes selection of an optimal exon by repositioning a downstream 5' splice site in preprotachykinin pre- mRNA. *Genes Dev*, **4**, 1172-1184.
- Newman, A. (1994) Analysis of pre-mRNA splicing in yeast. In Higgins, S. and Hames, B. (eds.), *RNA processing: a practical approach*. Oxford University Press, Oxford, United Kingdom, pp. 179-195.
- Newman, A. and Norman, C. (1991) Mutations in yeast U5 snRNA alter the specificity of 5' splice-site cleavage. *Cell*, **65**, 115-123.
- Newman, A.J. (1997) The role of U5 snRNP in pre-mRNA splicing. *EMBO J*, **16**, 5797-5800.
- Newman, A.J., Lin, R.J., Cheng, S.C. and Abelson, J. (1985) Molecular consequences of specific intron mutations on yeast mRNA splicing in vivo and in vitro. *Cell*, **42**, 335-344.
- Newman, A.J. and Norman, C. (1992) U5 snRNA interacts with exon sequences at 5' and 3' splice sites. *Cell*, **68**, 743-754.
- Newman, A.J., Teigelkamp, S. and Beggs, J.D. (1995) snRNA interactions at 5' and 3' splice sites monitored by photoactivated crosslinking in yeast spliceosomes. *RNA*, **1**, 968-980.
- Ng, R. and Abelson, J. (1980) Isolation and sequence of the gene for actin in Saccharomyces cerevisiae. *Proc Natl Acad Sci U S A*, **77**, 3912-3916.
- Nilsen, T. (1997) *Trans*-splicing. In Krainer, A. (ed.) *Eukaryotic mRNA processing*. Oxford University Press, Oxford, United Kingdom, pp. 310-344.
- Nilsen, T. (1998) RNA-RNA interactions in nuclear pre-mRNA splicing. In Simons, R. and Grunberg-Manago, M. (eds.), *RNA Structure and Function*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, pp. 279-307.

- Niwa, M. and Berget, S. (1991) Mutation of the AAUAAA polyadenylation signal depresses in vitro splicing of proximal but not distal introns. *Genes Dev*, **5**, 2086-2095.
- Niwa, M., Sidrauski, C., Kaufman, R.J. and Walter, P. (1999) A role for presenilin-1 in nuclear accumulation of Ire1 fragments and induction of the mammalian unfolded protein response. *Cell*, **99**, 691-702.
- Noble, S.M. and Guthrie, C. (1996) Identification of novel genes required for yeast premRNA splicing by means of cold-sensitive mutations. *Genetics*, **143**, 67-80.
- O'Day, C., Dalbadie-McFarland, G. and Abelson, J. (1996) The Saccharomyces cerevisiae Prp5 protein has RNA dependent ATPase activity with specificity for U2 small nuclear RNA. *J Biol Chem*, **271**, 33261-33267.
- O'Keefe, R., Norman, C. and Newman, A. (1996) The invariant U5 snRNA loop 1 sequence is dispensable for the first catalytic step of pre-mRNA splicing in yeast. *Cell*, **86**, 679-689.
- Ogden, R.C., Lee, M.C. and Knapp, G. (1984) Transfer RNA splicing in Saccharomyces cerevisiae: defining the substrates. *Nucleic Acids Res*, **12**, 9367-9382.
- Ohno, M., Sakamoto, H. and Shimura, Y. (1987) Preferential excision of the 5' proximal intron from mRNA precursors with two introns as mediated by the cap structure. *Proc Natl Acad Sci U S A*, **84**, 5187-5191.
- Padgett, R.A., Grabowski, P.J., Konarska, M.M., Seiler, S. and Sharp, P.A. (1986) Splicing of messenger RNA precursors. *Annu Rev Biochem*, 55, 1119-1150.
- Padgett, R.A., Hardy, S.F. and Sharp, P.A. (1983) Splicing of adenovirus RNA in a cell-free transcription system. *Proc Natl Acad Sci U S A*, **80**, 5230-5234.
- Padgett, R.A., Konarska, M.M., Grabowski, P.J., Hardy, S.F. and Sharp, P.A. (1984) Lariat RNA's as intermediates and products in the splicing of messenger RNA precursors. *Science*, 225, 898-903.
- Palmer, J. and Logsdon, J. (1991) The recent origin of introns. *Curr Opin Genet Dev*, **1**, 470-477.
- Parker, R., Siliciano, P.G. and Guthrie, C. (1987) Recognition of the TACTAAC box during mRNA splicing in yeast involves base pairing to the U2-like snRNA. *Cell*, **49**, 229-239.
- Pascolo, E. and Séraphin, B. (1997) The branch point residue is recognized during commitment complex formation prior to being bulged out of the U2 snRNA - pre-mRNA duplex. *Mol Cell Biol*, 17, 3469-3476.
- Patterson, B. and Guthrie, C. (1991) A U-rich tract enhances usage of an alternative 3' splice site in yeast. *Cell*, **64**, 181-187.
- Patton, J.R. (1994) Pseudouridine formation in small nuclear RNAs. *Biochimie*, **76**, 1129-1132.

- Patzelt, E., Perry, K.L. and Agabian, N. (1989) Mapping of branch sites in trans-spliced pre-mRNAs of Trypanosoma brucei. *Mol Cell Biol*, **9**, 4291-4297.
- Peebles, C.L., Perlman, P.S., Mecklenburg, K.L., Petrillo, M.L., Tabor, J.H., Jarrell, K.A. and Cheng, H.L. (1986) A self-splicing RNA excises an intron lariat. *Cell*, **44**, 213-223.
- Perriman, R. and Ares, M., Jr. (2000) ATP can be dispensable for prespliceosome formation in yeast. *Genes Dev*, **14**, 97-107.
- Pikielny, C.W. and Rosbash, M. (1985) mRNA splicing efficiency in yeast and the contribution of nonconserved sequences. *Cell*, **41**, 119-126.
- Pikielny, C.W. and Rosbash, M. (1986) Specific small nuclear RNAs are associated with yeast spliceosomes. *Cell*, **45**, 869-877.
- Pikielny, C.W., Rymond, B.C. and Rosbash, M. (1986) Electrophoresis of ribonucleoproteins reveals an ordered assembly pathway of yeast splicing complexes. *Nature*, **324**, 341-345.
- Plessel, G., Fischer, U. and Lührmann, R. (1994) m3G cap hypermethylation of U1 small nuclear ribonucleoprotein (snRNP) in vitro: evidence that the U1 small nuclear RNA-(guanosine-N2)- methyltransferase is a non-snRNP cytoplasmic protein that requires a binding site on the Sm core domain. *Mol Cell Biol*, **14**, 4160-4172.
- Polaina, J. and Adam, A.C. (1991) A fast procedure for yeast DNA purification. *Nucleic Acids Res*, **19**, 5443.
- Potashkin, J., Naik, K. and Wentz-Hunter, K. (1993) U2AF homolog required for splicing in vivo. *Science*, **262**, 573-575.
- Puig, O., Gottschalk, A., Fabrizio, P. and Séraphin, B. (1999) Interaction of the U1 snRNP with nonconserved intronic sequences affects 5' splice site selection. *Genes Dev*, 13, 569-580.
- Puig, O., Rutz, B., Luukkonen, B.G., Kandels-Lewis, S., Bragado-Nilsson, E. and Séraphin,
 B. (1998) New constructs and strategies for efficient PCR-based gene manipulations in yeast. *Yeast*, 14, 1139-1146.
- Query, C.C., Moore, M.J. and Sharp, P.A. (1994) Branch nucleophile selection in premRNA splicing: evidence for the bulged duplex model. *Genes Dev*, **8**, 587-597.
- Raghunathan, P.L. and Guthrie, C. (1998) A spliceosomal recycling factor that reanneals U4 and U6 small nuclear ribonucleoprotein particles. *Science*, **279**, 857-860.
- Rain, J.C. and Legrain, P. (1997) In vivo commitment to splicing in yeast involves the nucleotide upstream from the branch site conserved sequence and the Mud2 protein. *EMBO J*, 16, 1759-1771.

- Rain, J.C., Rafi, Z., Rhani, Z., Legrain, P. and Krämer, A. (1998) Conservation of functional domains involved in RNA binding and protein- protein interactions in human and Saccharomyces cerevisiae pre-mRNA splicing factor SF1. *RNA*, 4, 551-565.
- Reed, R. (1989) The organization of 3' splice-site sequences in mammalian introns. *Genes Dev*, **3**, 2113-2123.
- Reich, C., VanHoy, R., Porter, G. and Wise, J. (1992) Mutations at the 3' splice site can be suppressed by compensatory base changes in U1 snRNA in fission yeast. *Cell*, **69**, 1159-1169.
- Reyes, J., Kois, P., Konforti, B. and Konarska, M. (1996) The canonical GU dinucleotide at the 5' splice site is recognized by p220 of the U5 snRNP within the spliceosome. *RNA*, 2, 213-225.
- Reyes, J.L., Gustafson, E.H., Luo, H.R., Moore, M.J. and Konarska, M.M. (1999) The C-terminal region of hPrp8 interacts with the conserved GU dinucleotide at the 5' splice site. *RNA*, **5**, 167-179.
- Rigaut, G., Shevchenko, A., Rutz, B., Wilm, M., Mann, M. and Séraphin, B. (1999) A generic protein purification method for protein complex characterization and proteome exploration. *Nat Biotechnol*, **17**, 1030-1032.
- Robberson, B.L., Cote, G.J. and Berget, S.M. (1990) Exon definition may facilitate splice site selection in RNAs with multiple exons. *Mol Cell Biol*, **10**, 84-94.
- Rosbash, M. and Séraphin, B. (1991) Who's on first? The U1 snRNP-5' splice site interaction and splicing. *Trends Biochem Sci*, **16**, 187-190.
- Rost, B. and Sander, C. (1993) Prediction of protein secondary structure at better than 70% accuracy. *J Mol Biol*, **232**, 584-599.
- Rost, B. and Sander, C. (1994) Combining evolutionary information and neural networks to predict protein secondary structure. *Proteins*, **19**, 55-72.
- Ruby, S.W. (1997) Dynamics of the U1 small nuclear ribonucleoprotein during yeast spliceosome assembly. *J Biol Chem*, **272**, 17333-17341.
- Ruby, S.W., Chang, T.H. and Abelson, J. (1993) Four yeast spliceosomal proteins (PRP5, PRP9, PRP11, and PRP21) interact to promote U2 snRNP binding to pre-mRNA. *Genes Dev*, 7, 1909-1925.
- Ruskin, B., Krainer, A.R., Maniatis, T. and Green, M.R. (1984) Excision of an intact intron as a novel lariat structure during pre-mRNA splicing in vitro. *Cell*, **38**, 317-331.
- Ruskin, B., Zamore, P.D. and Green, M.R. (1988) A factor, U2AF, is required for U2 snRNP binding and splicing complex assembly. *Cell*, **52**, 207-219.

- Rymond, B.C. and Rosbash, M. (1993) Yeast pre-mRNA splicing. In Broach, J.R., Pringle, J.R. and Jones, E.W. (eds.), *Molecular and Cellular Biology of the Yeast Saccharomyces*. Cold Spring Harbor Press, Cold Spring Harbor, Vol. 2, p.
- Salgado-Garrido, J., Bragado-Nilsson, E., Kandels-Lewis, S. and Séraphin, B. (1999) Sm and Sm-like proteins assemble in two related complexes of deep evolutionary origin. *EMBO J*, 18, 3451-3462.
- Sambrook, J., Fritsch, E. and Maniatis, T. (1989) *Molecular cloning a laboratory manual*. Cold Spring Harbor Press, New York, NY.
- Sanger, F., Nicklen, S. and Coulson, A.R. (1977) DNA sequencing with chain-terminating inhibitors. *Proc Natl Acad Sci USA*, **74**, 5463-5467.
- Segault, V., Will, C.L., Sproat, B.S. and Lührmann, R. (1995) In vitro reconstitution of mammalian U2 and U5 snRNPs active in splicing: Sm proteins are functionally interchangeable and are essential for the formation of functional U2 and U5 snRNPs. *EMBO J*, **14**, 4010-4021.
- Senapathy, P., Shapiro, M.B. and Harris, N.L. (1990) Splice junctions, branch point sites, and exons: Sequence statistics, identification, and applications to genome project. In Doolittle, R.F. (ed.) *Methods in Enzymology*. Academic Press, Inc., Vol. 183, pp. 252-278.
- Séraphin, B. (1995) Sm and Sm-like proteins belong to a large family: identification of proteins of the U6 as well as the U1, U2, U4 and U5 snRNPs. *EMBO J.*, **14**, 2089-2098.
- Séraphin, B. and Kandels-Lewis, S. (1993) 3' splice site recognition in S. cerevisiae does not require base pairing with U1 snRNA. *Cell*, **73**, 803-812.
- Séraphin, B., Kretzner, L. and Rosbash, M. (1988) A U1 snRNA:pre-mRNA base pairing interaction is required early in yeast spliceosome assembly but does not uniquely define the 5' cleavage site. *EMBO J.*, **7**, 2533-2538.
- Séraphin, B. and Rosbash, M. (1989) Identification of functional U1 snRNA-pre-mRNA complexes committed to spliceosome assembly and splicing. *Cell*, **59**, 349-358.
- Séraphin, B. and Rosbash, M. (1991) The yeast branchpoint sequence is not required for the formation of a stable U1 snRNA-pre-mRNA complex and is recognized in the absence of U2 snRNA. *EMBO J*, **10**, 1209-1216.
- Sharp, P.A. (1985) Splicing of messenger RNA precursors. Harvey Lect, 81, 1-31.
- Sherman, F., Fink, J. and Hicks, J. (1983) *Methods in yeast genetics*. Cold Spring Harbor Press, New York, NY.
- Shevchenko, A., Wilm, M., Vorm, O. and Mann, M. (1996) Mass spectrometric sequencing of proteins silver-stained polyacrylamide gels. *Anal Chem*, **68**, 850-858.

- Sidrauski, C., Cox, J. and Walter, P. (1996) tRNA ligase is required for regulated mRNA splicing in the unfolded protein response. *Cell*, **87**, 405-413.
- Sidrauski, C. and Walter, P. (1997) The transmembrane kinase Ire1p is a site-specific endonuclease that initiates mRNA splicing in the unfolded protein response. *Cell*, **90**, 1031-1039.
- Sikorski, R. and Hieter, P. (1989) A system of shuttle vectors and yeast host strains designed for efficient manipulation of DNA in Saccharomyces cerevisiae. *Genetics*, **122**, 19-27.
- Smith, C.W., Chu, T.T. and Nadal Ginard, B. (1993) Scanning and competition between AGs are involved in 3' splice site selection in mammalian introns. *Mol Cell Biol*, **13**, 4939-4952.
- Smith, C.W. and Nadal Ginard, B. (1989) Mutually exclusive splicing of alpha-tropomyosin exons enforced by an unusual lariat branch point location: implications for constitutive splicing. *Cell*, **56**, 749-758.
- Smith, C.W., Patton, J.G. and Nadal Ginard, B. (1989a) Alternative splicing in the control of gene expression. *Annu Rev Genet*, **23**, 527-577.
- Smith, C.W., Porro, E.B., Patton, J.G. and Nadal Ginard, B. (1989b) Scanning from an independently specified branch point defines the 3' splice site of mammalian introns. *Nature*, 342, 243-247.
- Soni, R. and Carmichael, J.P. (1993) Parameters affecting lithium acetate-mediated transformation of S. cerevisiae and development of a rapid and simplified procedure. *Curr Genet*, **24**, 455-459.
- Sontheimer, E.J. and Steitz, J.A. (1993) The U5 and U6 small nuclear RNAs as active site components of the spliceosome. *Science*, **262**, 1989-1996.
- Spingola, M., Grate, L., Haussler, D. and Ares, M., Jr. (1999) Genome-wide bioinformatic and molecular analysis of introns in Saccharomyces cerevisiae. *RNA*, **5**, 221-234.
- Staknis, D. and Reed, R. (1994) SR proteins promote the first specific recognition of PremRNA and are present together with the U1 small nuclear ribonucleoprotein particle in a general splicing enhancer complex. *Mol Cell Biol*, **14**, 7670-7682.
- Staley, J.P. and Guthrie, C. (1998) Mechanical devices of the spliceosome: motors, clocks, springs, and things. *Cell*, **92**, 315-326.
- Staley, J.P. and Guthrie, C. (1999) An RNA switch at the 5' splice site requires ATP and the DEAD box protein Prp28p. *Mol Cell*, **3**, 55-64.
- Stoltzfus, A., Spencer, D.F., Zuker, M., Logsdon, J.M., Jr. and Doolittle, W.F. (1994) Testing the exon theory of genes: the evidence from protein structure. *Science*, **265**, 202-207.

Stutz, F. and Rosbash, M. (1998) Nuclear RNA export. Genes Dev, 12, 3303-3319.

- Sun, J.S. and Manley, J.L. (1995) A novel U2-U6 snRNA structure is necessary for mammalian mRNA splicing. *Genes Dev*, **9**, 843-854.
- Tarn, W.-Y. and Steitz, J. (1994) SR proteins can compensate for the loss of U1 snRNP functions in vitro. *Genes Dev*, **8**, 2704-2717.
- Tarn, W.-Y. and Steitz, J. (1996a) Highly diverged U4 and U6 small nuclear RNAs required for splicing rare AT-AC introns. *Science*, **273**, 1824-1832.
- Tarn, W.-Y. and Steitz, J. (1996b) A novel spliceosome containing U11, U12 and U5 snRNPs excises a minor class (AT-AC) intron in vitro. *Cell*, **84**, 801-811.
- Teem, J.L. and Rosbash, M. (1983) Expression of a beta-galactosidase gene containing the ribosomal protein 51 intron is sensitive to the rna2 mutation of yeast. *Proc Natl Acad Sci* USA, 80, 4403-4407.
- Teigelkamp, S., Achsel, T., Mundt, C., Gothel, S.F., Cronshagen, U., Lane, W.S., Marahiel, M. and Lührmann, R. (1998) The 20kD protein of human [U4/U6.U5] tri-snRNPs is a novel cyclophilin that forms a complex with the U4/U6-specific 60kD and 90kD proteins. *RNA*, 4, 127-141.
- Teigelkamp, S., Newman, A.J. and Beggs, J.D. (1995) Extensive interactions of PRP8 protein with the 5' and 3' splice sites during splicing suggest a role in stabilization of exon alignment by U5 snRNA. *EMBO J*, **14**, 2602-2612.
- Thompson, J.D., Gibson, T.J., Plewniak, F., Jeanmougin, F. and Higgins, D.G. (1997) The CLUSTAL_X windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Res*, **25**, 4876-4882.
- Thompson, J.D., Higgins, D.G. and Gibson, T.J. (1994) Improved sensitivity of profile searches through the use of sequence weights and gap excision. *Comput Appl Biosci*, **10**, 19-29.
- Toda, T., Iida, A., Miwa, T., Nakamura, Y. and Imai, T. (1994) Isolation and characterization of a novel gene encoding nuclear protein at a locus (D11S636) tightly linked to multiple endocrine neoplasia type 1 (MEN1). *Hum Mol Genet*, **3**, 465-470.
- Umen, J.G. and Guthrie, C. (1995a) Prp16p, Slu7p, and Prp8p interact with the 3' splice site in two distinct stages during the second catalytic step of pre-mRNA splicing. *RNA*, 1, 584-597.
- Umen, J.G. and Guthrie, C. (1995b) The second catalytic step of pre-mRNA splicing. *RNA*, **1**, 869-885.
- Vagner, S., Ruegsegger, U., Gunderson, S.I., Keller, W. and Mattaj, I.W. (2000a) Positiondependent inhibition of the cleavage step of pre-mRNA 3'-end processing by U1 snRNP. *RNA*, 6, 178-188.

- Vagner, S., Vagner, C. and Mattaj, I.W. (2000b) The carboxyl terminus of vertebrate poly(A) polymerase interacts with U2AF 65 to couple 3'-end processing and splicing. *Genes Dev*, **14**, 403-413.
- Valcárcel, J., Gaur, R., Singh, R. and Green, M. (1996) Interaction of U2AF65 RS region with pre-mRNA of branch point and promotion of base pairing with U2 snRNA. *Science*, **273**, 1706-1709.
- Valcárcel, J., Singh, R., Zamore, P.D. and Green, M.R. (1993) The protein Sex-lethal antagonizes the splicing factor U2AF to regulate alternative splicing of transformer premRNA. *Nature*, **362**, 171-175.
- van der Veen, R., Arnberg, A., van der Horst, G., Bonen, L., Tabak, F. and Grivell, L. (1986) Excised group II introns in yeast mitochondria are lariats and can be formed by self-splicing in vitro. *Cell*, **44**, 225-234.
- Vernet, C. and Artzt, K. (1997) STAR, a gene family involved in signal transduction and activation of RNA. *Trends Genet*, **13**, 479-484.
- Vijayraghavan, U., Company, M. and Abelson, J. (1989) Isolation and characterization of pre-mRNA splicing mutants of Saccharomyces cerevisiae. *Genes Dev*, **3**, 1206-1216.
- Vilardell, J. and Warner, R. (1994) Regulation of splicing at an intermediate step in the formation of the spliceosome. *Genes Dev*, **8**, 211-220.
- Wang, X., Bruderer, S., Rafi, Z., Xue, J., Milburn, P.J., Krämer, A. and Robinson, P.J. (1999) Phosphorylation of splicing factor SF1 on Ser20 by cGMP-dependent protein kinase regulates spliceosome assembly. *EMBO J*, **18**, 4549-4559.
- Wassarman, D.A. and Steitz, J.A. (1993a) A base-pairing interaction between U2 and U6 small nuclear RNAs occurs in > 150S complexes in HeLa cell extracts: implications for the spliceosome assembly pathway. *Proc Natl Acad Sci USA*, **90**, 7139-7143.
- Wassarman, K.M. and Steitz, J.A. (1993b) Association with terminal exons in pre-mRNAs: a new role for the U1 snRNP? *Genes Dev*, **7**, 647-659.
- Watson, J. and Crick, F. (1953) Molecular structure of nucleic acids. *Nature*, 171, 737-738.
- Wells, S.E., Neville, M., Haynes, M., Wang, J., Igel, H. and Ares, M., Jr. (1996) CUS1, a suppressor of cold-sensitive U2 snRNA mutations, is a novel yeast splicing factor homologous to human SAP 145. *Genes Dev*, **10**, 220-232.
- Will, C.L., Schneider, C., Reed, R. and Lührmann, R. (1999) Identification of both shared and distinct proteins in the major and minor spliceosomes. *Science*, **284**, 2003-2005.
- Woolford, J.L., Jr. and Peebles, C.L. (1992) RNA splicing in lower eukaryotes. *Curr Opin Genet Dev*, **2**, 712-719.

- Wrehlke, C., Schmitt-Wrede, H.P., Qiao, Z. and Wunderlich, F. (1997) Enhanced expression in spleen macrophages of the mouse homolog to the human putative tumor suppressor gene ZFM1. *DNA Cell Biol*, 16, 761-767.
- Wrehlke, C., Wiedemeyer, W.R., Schmitt-Wrede, H.P., Mincheva, A., Lichter, P. and Wunderlich, F. (1999) Genomic organization of mouse gene zfp162. *DNA Cell Biol*, 18, 419-428.
- Wu, H.-J., Gaubier-Comella, P., Delseny, M., Grellet, F., Van Montagu, M. and Rouzé, P. (1996) Non-canonical introns are at least 10*9 years old. *Nat Genet*, 14, 383-384.
- Wu, J. and Manley, J.L. (1989) Mammalian pre-mRNA branch site selection by U2 snRNP involves base pairing. *Genes Dev*, **3**, 1553-1561.
- Wu, J.A. and Manley, J.L. (1991) Base pairing between U2 and U6 snRNAs is necessary for splicing of a mammalian pre-mRNA. *Nature*, **352**, 818-821.
- Wu, J.Y. and Maniatis, T. (1993) Specific interactions between proteins implicated in splice site selection and regulated alternative splicing. *Cell*, **75**, 1061-1070.
- Wu, S., Romfo, C.M., Nilsen, T.W. and Green, M.R. (1999) Functional recognition of the 3' splice site AG by the splicing factor U2AF35. *Nature*, **402**, 832-835.
- Wyatt, J., Sontheimer, E. and Steitz, J. (1992) Site-specific cross-linking of mammalian U5 snRNP to the 5' splice site before the first step of pre-mRNA splicing. *Genes Dev*, **6**, 2542-2553.
- Yan, P., Eulenstein, O., Vingron, M. and Bork, P. (1998) Towards detection of orthologues in sequence databases. *Bioinformatics*, 14, 285-289.
- Yu, Y.T., Shu, M.D. and Steitz, J.A. (1998) Modifications of U2 snRNA are required for snRNP assembly and pre-mRNA splicing. *EMBO J*, 17, 5783-5795.
- Yuo, C.Y., Ares, M., Jr. and Weiner, A.M. (1985) Sequences required for 3' end formation of human U2 small nuclear RNA. *Cell*, **42**, 193-202.
- Zamore, P.D. and Green, M.R. (1989) Identification, purification, and biochemical characterization of U2 small nuclear ribonucleoprotein auxiliary factor. *Proc Natl Acad Sci U S A*, **86**, 9243-9247.
- Zamore, P.D., Patton, J.G. and Green, M.R. (1992) Cloning and domain structure of the mammalian splicing factor U2AF. *Nature*, **355**, 609-614.
- Zaug, A.J., Grabowski, P.J. and Cech, T.R. (1983) Autocatalytic cyclization of an excised intervening sequence RNA is a cleavage-ligation reaction. *Nature*, **301**, 578-583.
- Zhang, D. and Childs, G. (1998) Human ZFM1 protein is a transcriptional repressor that interacts with the transcription activation domain of stage-specific activator protein. J Biol Chem, 273, 6868-6877.

- Zhang, D. and Rosbash, M. (1999) Identification of eight proteins that cross-link to premRNA in the yeast commitment complex. *Genes Dev*, **13**, 581-592.
- Zhuang, Y. and Weiner, A.M. (1989) A compensatory base change in human U2 snRNA can suppress a branch site mutation. *Genes Dev*, **3**, 1545-1552.
- Zorio, D.A. and Blumenthal, T. (1999) Both subunits of U2AF recognize the 3' splice site in Caenorhabditis elegans. *Nature*, **402**, 835-838.
- Zuo, P. and Manley, J.L. (1994) The human splicing factor ASF/SF2 can specifically recognize pre-mRNA 5' splice sites. *Proc Natl Acad Sci U S A*, **91**, 3363-3367.