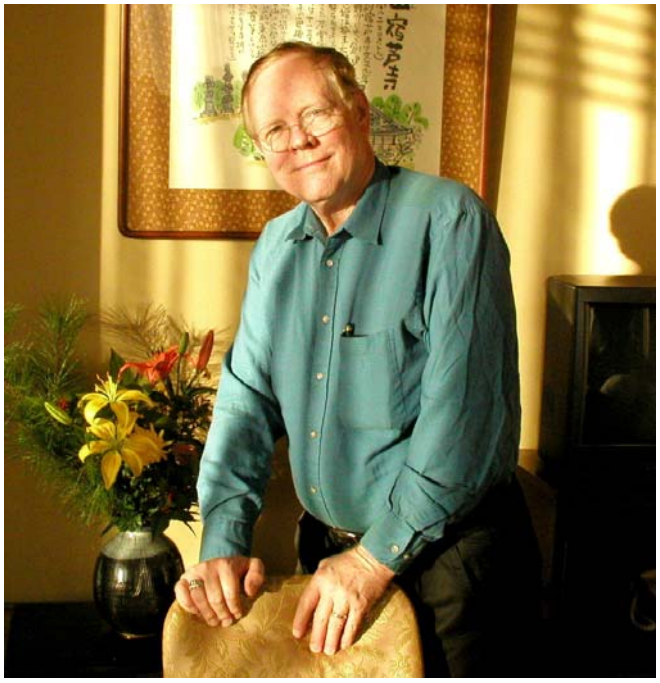
Highlights of the Research Career

of

R. Malcolm Brown, Jr.

1962 -- 2008



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1. Airborne algae- This was his first major thrust as a graduate student. It basically opened up a new field of research for algae. One unexpected highlight is that many people were found to be allergic to algae, and they build up sensitivity by breathing dust with algal components in it.

McElhenny, T.R., H.C. Bold, R.M. Brown, Jr. and J.P. McGovern. 1962. Algae: a cause of inhalant allergy in children. *Ann. Allergy* **20**:739-743.

Brown, R.M., Jr., D.A. Larson, and H.C. Bold. 1964. Airborne algae: their abundance and heterogeneity. *Science* **143**:583-585.

Brown, R.M., Jr., 1971. Studies of Hawaiian fresh-water and soil algae. I. the atmospheric dispersal of algae and fern spores across the island of Oahu, Hawaii. *Contributions in Phycology.* Sept. 1971, 175-188.

Brown, R.M., Jr. 1972. Atmospheric transport of algae in Hawaii. IN: Proceedings Workshop/Conference I. Ecological systems approaches to aerobiology. I. Identification of component elements and their function relationships. U.S. IBP Handbook #2 (W.S. Benninghoff and R.L. Edmonds, eds.). pp. 133-136.

Schlichting, H.E., Jr., R.M. Brown, Jr. and P.E. Smith. 1973. Airborne algae of Hawaii: a model for coordinated aerobiological research. IN: Proceeding Workshop/Conference I. Ecological systems approaches to aerobiology. II. Development, demonstration, and evaluation of models. U.S. IBP Handbook #3 (W.S. Benninghoff and R.L. Edmonds, eds.). pp. 150-155.

Carson, J.L. and R.M. Brown, Jr. 1976. The correlation of soil algae, airborne algae, and fern spores with meteorological conditions on the island of Hawaii. *Pacific Science* **30**(2):197-205.

Carson, J.L. and R.M. Brown, Jr. 1978. Studies of Hawaiian freshwater and soil algae. II. Colonization and succession of algae on dated volcanic substrates. *J. Phycol.* **14**(2):171-178.

2. Algal taxonomy using ultrastructure and immunological approaches- This was developed while a graduate student also. Because of limited morphology, the ultrastructural approach combined with an immunological approach turned out to be very helpful to identify a number of soil and airborne algae.

Brown, R.M., Jr. and R.N. Lester. 1965. Comparative immunology of the algal genera *Tetracystis* and *Chlorococcum. J. Phycol.* **2**:60-65.

Brown, R.M., Jr., and P.L. Walne. 1967. Comparative immunology of selected wild types, varieties, and mutants of *Chlamydomonas. J. Protozool.* **14**:365-373.

Brown, R.M., Jr. and R.J. McLean. 1969. New taxonomic criteria in classification of *Chlorococcum* species. II. Pyrenoid structure. *J. Phycol.* **5**:114-118.

3. He pioneered in the first electron microscopic characterization of algal viruses. This work was accomplished in collaboration with Professor Kenneth Smith of Cambridge University, England who was a visiting scholar at UT-Austin at the time.

Brown, R.M., Jr., K.M. Smith, and P.L. Walne. 1966. The replication cycle of the blue-green algal virus LPP-1. *Nature* **212**:729-730.

Smith, K.M., R.M. Brown, Jr., D. Goldstein, and P.L. Walne. 1966. Culture methods for the blue-green alga *Plectonema boryanum* and its virus, with an electron microscope study of virus-infected cells. *Virology* **28**:580-591.

Smith, K.M., R.M. Brown, Jr., and P.L. Walne. 1966. Electron microscopy of the infection process of the blue-green alga virus. *Virology* **30**:182-192.

Smith, K.M., R.M. Brown, Jr., and P.L. Walne. 1967. Ultrastructural and time-lapse studies on the replication cycle of the blue-green algal virus LPP-1. *Virology* **31**:329-337.

Sherman, L. and R.M. Brown, Jr. 1978. Cyanophages and viruses of eukaryotic algae. IN: Comprehensive Virology **12**:145-234. Plenum Press, New York.

4. A discovery that cellulose can be made in the Golgi apparatus. This was important because before this, it was thought that it was impossible to have cellulose synthesized in this organelle.

Brown, R.M., Jr. 1969. Observations on the relationship of the Golgi apparatus to wall formation in the marine chrysophycean alga, *Pleurochrysis scherffelii*. *J. Cell Biol*. **41**:109-123.

Brown, R.M., Jr., W.W. Franke, H. Kleinig, H. Falk, and P. Sitte. 1969. A cellulosic wall component produced by the Golgi apparatus. *Science* **166**:894-896.

Brown, R.M., Jr., W.W. Franke, H. Kleinig, H. Falk, and P. Sitte. 1970. Scale formation in chrysophycean algae. I. Cellulosic and non-cellulosic wall components made by the Golgi apparatus. *J. Cell Biol*. **45**:246-271.

5. Discovery of the cellulose synthesizing complex which led to the general understanding of how cellulose is assembled by all living organisms, including land plants.

Brown, R.M., Jr. and D. Montezinos. 1976. Cellulose microfibrils: visualization of biosynthetic and orienting complexes in association with the plasma membrane. *Proc. Nat. Acad. Sci. U.S.A.* **73**:143-147.

Mueller, S., R.M. Brown, Jr. and T.K. Scott. 1976. Cellulosic microfibrils: nascent stages of synthesis in a higher plant cell. *Science* **194**:949-951.

Brown, R.M., Jr., J.H.M. Willison, and C. L. Richardson. 1976. Cellulose biosynthesis in *Acetobacter xylinum*: 1. Visualization of the site of synthesis and direct measurement of the *in vivo* process. *Proc. Nat. Acad. Sci. U.S.A.* **73**(12):4565-4569.

Hotchkiss, A.T., Jr. and R.M. Brown, Jr. 1987. The association of rosette and globule terminal complexes with cellulose microfibril assembly in *Nitella translucens* var. *axillaris* (Charophyceae). *J. Phycol*. **23**:229-237.

6. Ultrastructural elucidation of a fossil leaf gave way to the modern "Jurassic Park" concept and some of the first PCR results from ancient fossils.

Niklas, K.J., R.M. Brown, Jr., R. Santos, and B. Vian. 1978. Ultrastructure and cytochemistry of Miocene angiosperm leaf tissues. *Proc. Nat. Acad. Sci. U.S.A.* **75**:3263-3267.

Niklas, K.J., and R.M. Brown, Jr. 1981. Some chemophysical factors attending fossilization. *Bioscience* **31**(2):148-149.

7. Experimental alteration of cellulose biosynthesis *in vivo* giving new information for the separation of the polymerization and crystallization events.

Haigler, C., R.M. Brown, Jr. and M. Benziman. 1980. Calcofluor White ST alters the *in vivo* assembly of cellulose microfibrils. *Science* **210**:903-906 (cover).

Benziman, M., C.H. Haigler, R.M. Brown, Jr., A. R. White, and K. M. Cooper. 1980. Cellulose biogenesis: polymerization and crystallization are coupled processes in *Acetobacter xylinum. Proc. Nat. Acad. Sci. U.S.A.* **77**:6678-6682.

Haigler, C.H., A.R. White, R.M. Brown, Jr. and K.M. Cooper. 1982. Alteration of *in vivo* cellulose ribbon assembly by carboxymethyl-cellulose and other cellulose derivatives. *J. Cell Biol.* **94**:64-69.

Brown, R.M. Jr., C.H. Haigler, and K. Cooper. 1982. Experimental induction of altered nonmicrofibrillar cellulose. *Science* **218**:1141-1142.

Itoh, T., R.M. O'Neil, and R.M. Brown, Jr. 1984 Interference of cell wall regeneration of *Boergesenia forbesii* protoplasts by Tinopal LPW, a fluorescent brightening agent. *Protoplasma* **123**:174-183.

8. The first purification of cellulose synthase and cellulose I and II synthesized *in vitro*

Lin, F.C., R.M. Brown, Jr., J. Cooper, and D. Delmer. 1985. Synthesis of fibrils *in vitro* by a solubilized cellulose synthase from *Acetobacter xylinum. Science* **230**: 822-825.

Lin, F.C. and R.M. Brown, Jr. 1989. Purification of cellulose synthase from *Acetobacter xylinum*. In: Cellulose and Wood - Chemistry and Technology, Ed. C. Schuerch. John Wiley and Sons, Inc. N.Y., 473-492.

Lin, F.C., R. M. Brown, Jr., R. P. Drake, Jr., and B.E. Haley. 1990. Identification of the uridine 5'-diphosphoglucose (UDP-glc) binding subunit of cellulose synthase in Acetobacter xylinum using the photoaffinity probe 5-azido-UDP-glc. *J. Biol. Chem.* **265**: 4782-4784.

Okuda K., Li L., Kudlicka K., Kuga S., and R. M. Brown ,Jr. 1993. ß-glucan synthesis in the cotton fiber. I. Identification of ß-1,4- and ß-1,3- glucans synthesized *in vitro* . *Plant Physiol.* **101**: 1131-1142.

Li L., and R. M. Brown, Jr. 1993. ß-glucan synthesis in the cotton fiber. II. Regulation and kinetic properties of ß-glucan synthases. *Plant Physiol.* **101**: 1143-1148.

Li L., Drake, Jr. R. R. , Clement S., and R. M. Brown, Jr. 1993. ß-glucan synthesis in the cotton fiber. III. Identification of UDP-glucose-binding components of ß-glucan synthases by photoaffinity labeling with [ß-^{32}P]-5'N_3-UDP-glucose. *Plant Physiol.* **101**: 1149-1156.

9. The first cloning and sequencing of a cellulose synthase gene

Saxena, I. M., F. C. Lin, and R. M. Brown, Jr. 1990. Cloning and sequencing of the cellulose synthase catalytic subunit gene of *Acetobacter xylinum*. *Plant Molecular Biology* **15**:673-683.

Saxena, I. M. , F. C. Lin, and R. M. Brown, Jr. l99l. Identification of a new gene in an operon for cellulose biosynthesis in *Acetobacter xylinum*. *Plant Molecular Biology* **169**:947-954.

Saxena, I. M., and R. M. Brown, Jr. 1995. Identification of a second cellulose synthase gene (*acsAII*) in *Acetobacter xylinum*. *J. Bacteriology*. **177:** 5276-5283.

Saxena, I. M., Kudlicka, K., Okuda, K., and R. M. Brown, Jr. 1994. Characterization of genes in the cellulose synthesizing operon (acs operon) of *Acetobacter xylinum:* Implications for cellulose crystallization. *J. Bacteriology* **176**: 5735-5752.

10. Proof that the cellulose II allomorph has a folded chain conformation

Kuga, S., Takagi, S., and R. M. Brown, Jr. 1993. Native folded-chain cellulose II. *Polymer* **34**: 3293-3297.

11. The first assembly of synthetic cellulose I

Lee, J. H., Brown, Jr. R. M. , Kuga, S., Shoda, S., and S. Kobayashi. 1994. The first assembly of synthetic cellulose I. *Proc. Natl Acad. Sci. U.S.A.* **91**:7425-7429.

12. Multidomain architecture of B-glycosyl transferases provides crucial information leading to the discovery of cellulose synthase genes in vascular plants.

Saxena, I. M., Brown, Jr. R. M., Fevre, M., Geremia, R., and B. Henrissat. 1995. Multidomain architecture of glycosyl transferases: Implications for mechanism of action. *J. Bacteriology*. **177**: 1419-1324.

Saxena, I. M. and R. M. Brown, Jr. 1997. Identification of cellulose synthase(s) in higher plants: Sequence analysis of processive β-glycosyltransferases with the common motif "D, D, D35Q(R,Q)XRW." *Cellulose* **4:**33-49

13. Proof for van der Waals forces organizing B-glucan chain sheets as the first stage of native cellulose crystallization.

Cousins, S. K., and R. M. Brown, Jr. 1995. Cellulose I microfibril assembly: computational molecular mechanics energy analysis favours bonding by van der Waals forces as the initial step in crystallization. *Polymer* **36:**3885-3888.

Cousins, S. K. and R. M. Brown, Jr. 1997. X-ray diffraction and ultrastructural analyses of dye-altered celluloses support van der Waals forces as the initial step in cellulose crystallization. *Polymer*. **38:**897-902

Cousins, S. K., and R. M. Brown, Jr. 1997. Photoisomerization of a dye-altered β-1, 4 glucan sheet induces the crystallization of a cellulose-composite. *Polymer* **38:**903-912

14. *In vitro* separation of cellulose and callose

Kudlicka, K. and R. M. Brown, Jr. 1997. Cellulose and callose biosynthesis in higher plants. I. Solubilization and separation of (1-3)-and (1-4)-B-glucan synthase activities from mung bean. *Plant Physiology 115:643-656*

15. Proof that the rosette TC discovered in 1980 is the site for cellulose synthase

Kimura, S., Laosinchai, W., Itoh, T., Cui, X., Linder, R., and R. M. Brown, Jr. 1999.
Immunogold Labeling of Rosette Terminal Cellulose Synthesizing Complexes in A Vascular Plant *(Vigna angularis). The Plant Cell* **11:** 2075-2085.

16. Identification of a B-1,3 glucan synthase gene

Cui,X., Shin,H. and Brown,R.M. 1998. Cotton CFL1 gene shows homology to the yeast beta-1,3-glucan synthase subunit FKS1. *Genebank.* Accession No. AF085717.

Cui, X., Shin, H., Song, C., Laosinchai, W., Amano, Y. and R. M. Brown, Jr. 2001 A putative plant homolog of the yeast B-1,3-glucan synthase subunit FKS1 from cotton (*Gossypium hirsutum* L.) fibers. *Planta* **213:** 223-230.

17. The first synthesis of carbon megatubes

Mitchell, Daniel R., Brown Jr., R. Malcolm, Spires, Tara L., Romanovicz, Dwight K., and Richard J. Lagow. 2001. The Synthesis of Megatubes: New Dimensions in Carbon Materials, *Inorganic Chemistry*; **40** (12): 2751-2755.

18. Discovery of cellulose biosynthesis in the cyanobacteria and a suggested origin of vascular plant cellulose synthase

Nobles, D., Romanovicz, D., and R. M. Brown, Jr. 2001. Cellulose in Cyanobacteria: Origin of Vascular Plant Cellulose Synthase? *Plant Physiology* **127:**529-542

Nobles, Jr., D.R. and R. M. Brown, Jr. 2007 Many Paths up the Mountain: Tracking the Evolution of Cellulose Biosynthesis *In Cellulose: Molecular and Structural Biology*. Springer *pp 1-15.*

19. Proof for the localization of c-di-GMP activator of cellulose synthase in *Acetobacter xylinum*

Kimura, S., H.P. Chen, Kikuchi, G. , Saxena, I.M. , Brown, JR., R.M. and T. Itoh. 2001. Localization of c-di-GMP-binding protein on the linear TCs in *Acetobacter xylinum. J. Bacteriology* **183:** 5668-5674.

20. Imaging of T-4 bacteriophage using light microscopy

Delgado, R.M. III., M.J. Fink, and R.M. Brown, Jr. 1989. Imaging of submicron objects with the light microscope. *Proc. Royal Mic. Soc. London.* **154**(2):129-141.

21. Imaging of a new form of cellulose, "nematic ordered cellulose"

Kondo, T., Togawa, E. and R. M. Brown, Jr. 2001. "Nematic Ordered Cellulose"; A concept of glucan chain association. *Biomacromolecules* **2:** 1324-1330.

22. Invention and development of electronic paper as a revolutionary display for computer screens, books, magazines, newspapers, wall paper, and canvas

Shah, J. and R. M. Brown, Jr. 2004. Towards Electronic Paper Displays Made from Microbial Cellulose. *Appl. Microbiol. and Biotechnology* **66**: 352-355

Note: a company, ***RealPaper Displays, Inc.*** has been formed and the technology licensed. For information, visit the RealPaper website: http://www.realpaperdisplays.com/

23. Development of techniques for atomic and molecular imaging of beam sensitive materials using the transmission electron microscope

Visit the following URL sites:
http://www.botany.utexas.edu/facstaff/facpages/mbrown/ongres/jsharp.htm
http://www.botany.utexas.edu/facstaff/facpages/mbrown/ongres/tspires/nano.htm

24. Invention and development of nano-scale fabrication using the transmission electron microscope

Brown, Jr. R. M., Z. Barnes, C. Sawatari, and T. Kondo 2007. Polymer Manipulation and Nanofabrication in Real time Using Transmission Electron Microscopy. *Biomacromolecules* **8**: 70-76

US Patent 7,335,882 issued February 26, 2008. High resolution low dose transmission electron microscopy real-time imaging and manipulation of nano-scale objects in the electron beam

25. Contributions of microbial cellulose in the fields of medical products, wound healing, and emergency medicine

Czaja. W., Krystynowicz, K., Bielecki, S., and R.M. Brown, Jr. 2006. Microbial Cellulose--the Natural Power to Heal Wounds. *Biomaterials* **27**: 145-151.

Czaja, W. K., Young, D.J., Kawecki, M., and R.M. Brown, Jr. 2007. The Future of Prospects of Microbial Cellulose in Biomedical Applications. Biomacromolecules **8:** 1-12

Note: a new company, ***Global Cellulose, Inc.*** has been formed to market various medical and cosmetics products designed and produced from microbial cellulose.

26. Development of a new global cellulose crop for biofuels using cyanobacteria (in collaboration with Dr. David R. Nobles, Jr.)

International Patent W0/2008/042975 Compositions, Methods, and Systems for Producing Saccharides in Photosynthetic Prokaryotes (Cyanobacteria). International filing date: March 10, 2007.

Patent Applications recently published by the United States Patent and Trademark Office:

20080113413 Expression of Foreign Cellulose Synthase Genes in Photosynthetic Prokaryotes (Cyanobacteria)

20080085536 Production of Cellulose in Halophilic Photosynthetic Prokaryotes (Cyanobacteria)

20080085520 Production and Secretion of Glucose in Photosynthetic Prokaryotes (Cyanobacteria)

20080124767 Production and Secretion of Sucrose in Photosynthetic Prokaryotes (Cyanobacteria)

note: other provisional applications on this subject have been or are being filed by UT-Austin.

A new bioenergy company, ***Phykotek, Inc.*** has been formed (RM Brown Jr and David R. Nobles, Jr., founders) to commercialize the production of biofuels from cyanobacteria.

A White Paper, "The Future of Biofuels in Renewable Energy and Reduction of Global Warming" by RM Brown Jr and David R. Nobles Jr is available upon request.

Note: As of May, 2008, Malcolm is still employed full time by The University of Texas at Austin and is very active in research as evidenced by the undergraduates, graduate students, and post-docs working in his laboratory. He does not plan to retire soon! His hobbies include gardening, photography, and music composition (www.novelmusic.com). He is married to Ann Callaway Brown (47 years) and has two children (now grown), David, and Julie. He has a grandchild, Christopher.

Most of the above publication citations can be found in pdf format and downloaded from the RMB website. Visit: http://www.botany.utexas.edu/mbrown/papers/default.htm

version 4: 5-23-08