Preservation and Care of Philatelic Materials

Subsidiary Page 3
The Mechanism of Paper Deterioration

Figure 4 shows the beginning details of a generalized schematic representation of the composition of paper.

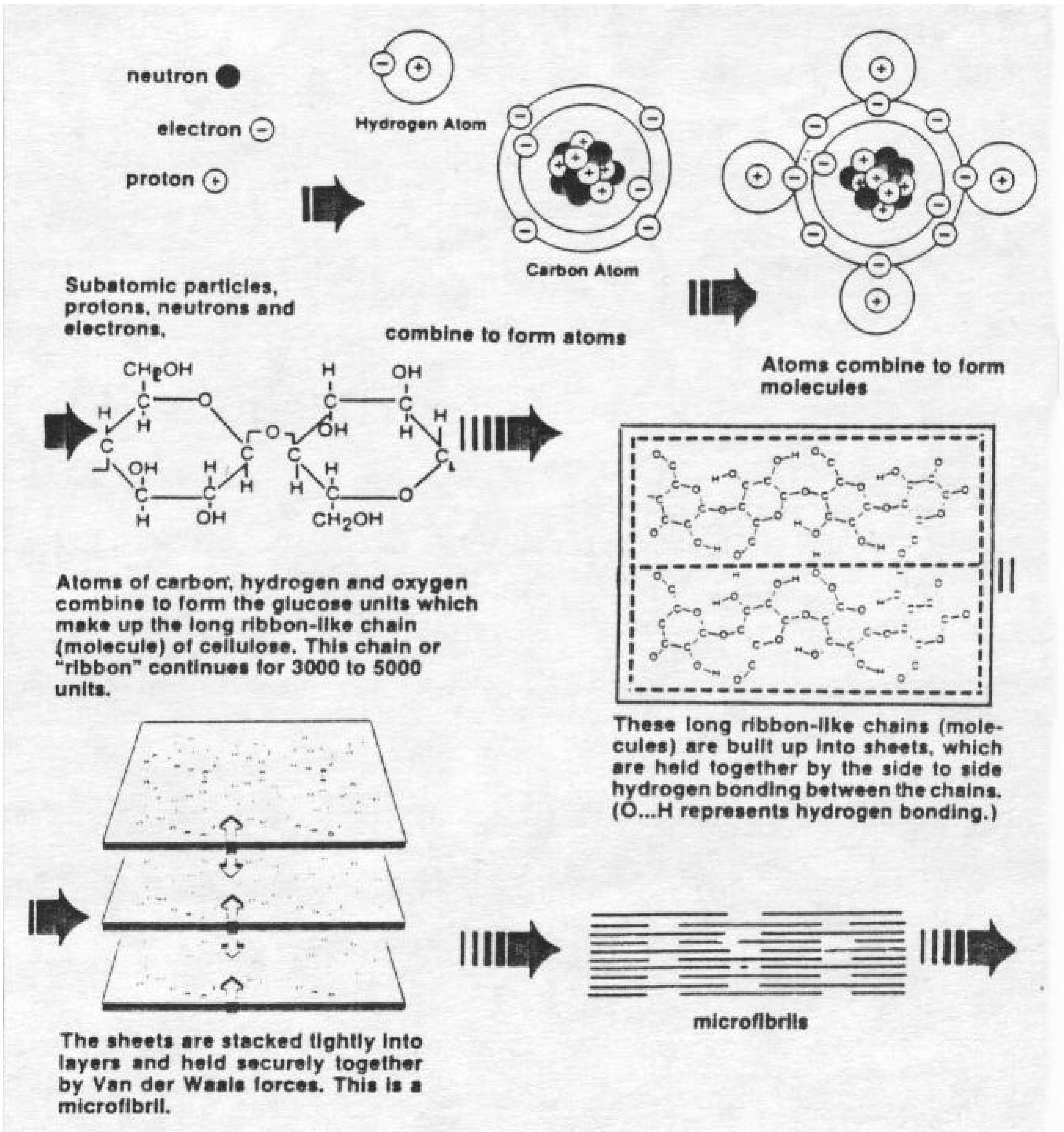

Figure 4. Schematic representation of composition of paper.

Three atoms -- carbon, hydrogen, and oxygen -- are the fundamental units of paper. They are combined in glucose molecules, which are combined in the cellulose chain. Two types of bonds -- hydrogen and covalent -- occur in the cellulose chain. The covalent bond is the primary force holding the glucose molecules together, while the weaker hydrogen bonds function in the formation of sheets. The sheets are held together by Van der Vaals forces, forming the microfibril. The final details of the structure of paper are shown in **Figure 5.**

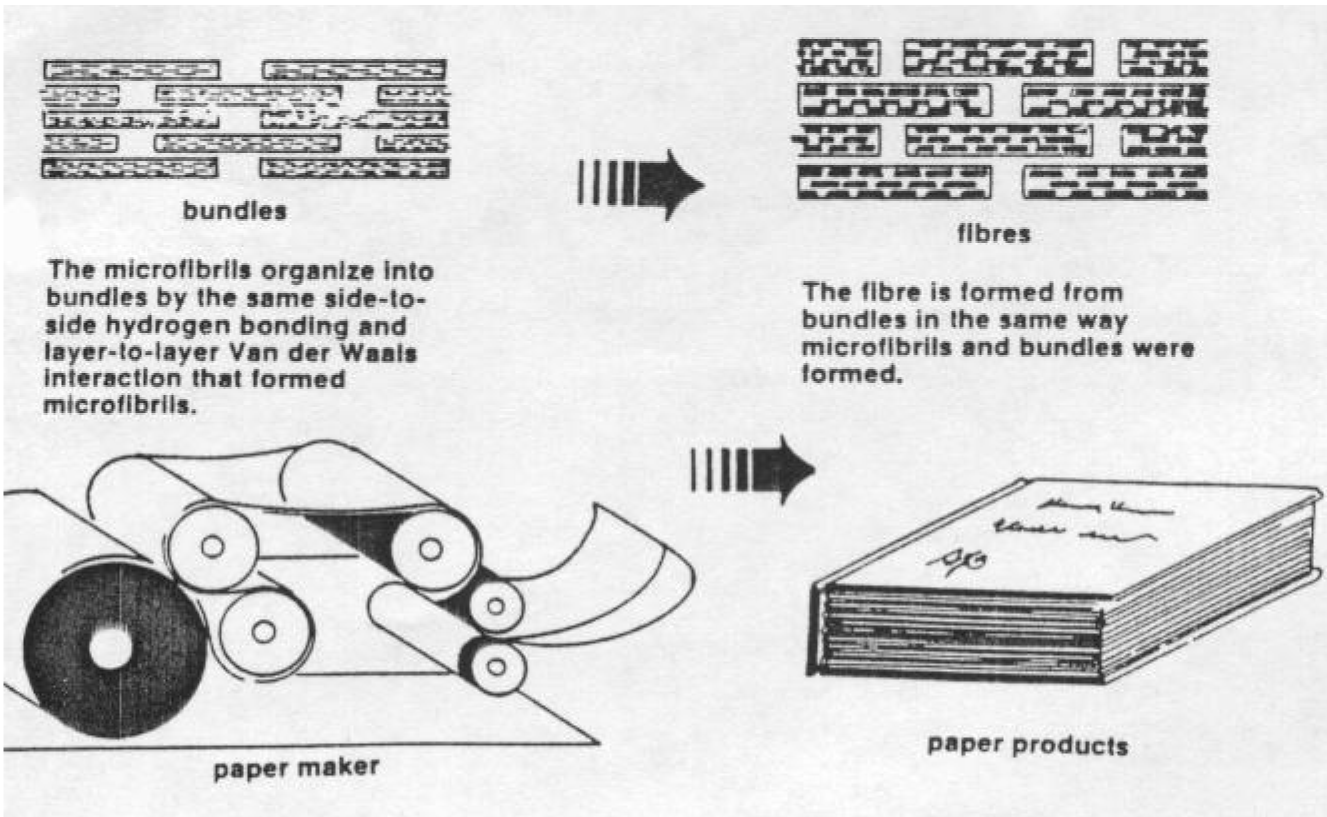

Figure 5. Final details of schematic representation of composition of paper.

The hydrogen ion (a postivitely charged hydrogen atom) is acidic and, when released, can cause the break of the covalent bond in the cellulose chain. A continuation of that process produces acidic degradation. Such impurities in paper as lignin, hemicellulose, hydrolyzed cellulose, and others will oxidize and produce acidic degrading of paper. Alum-rosin sizing added during paper manufacture is an acid producer. Pollutants in the atmosphere such as sulphur dioxide and nitrogen dioxide can form sulphuric acid and nitric acid, respectively. These acids can break the chemical bonds holding paper fibers together.

Acidity in paper has been determined to be the most single important cause of deterioration in modern papers. Acidity is measured by the pH number on a scale from 0 to 14. A pH of 7 is neutral. Above pH 7 is the alkaline range, while below pH7 is the acidic range.

Materials with a pH higher than 7 are described as alkaline-buffered. In some cases, such materials offer additional long-term protection against acids.

Prior to about 1850, papers were produced from linen and cotton rags. Such papers are relatively stable and, when properly stored and handled, will last literally for centuries. After 1850, as the demand for papers and utilization of them increased, alternatives to linen and cotton rags began to be used in paper manufacture. From about 1860 on, chemical wood pulp became more and more used until today the vast majority of modern papers are made from chemically treated wood pulp. Chemical treatment reduces the lignin content, and synthetic sizing agents are then added. It is the decomposition of residual lignin in paper which, in the presence of heat and light, presents the major problem to individuals wishing to preserve the papers concerned. Decomposition of lignin produces a strong organic acid and also promotes the absorption of atmospheric acid, although some wood pulp paper is manufactured with the lignin removed resulting in the paper having only a slightly acidic pH and in the paper being acceptable to many conservation purposes.

Campbell (1993) reported on a study to investigate the levels of acidity in commonly available album pages marked for mounting stamps. The resulting data are displayed in **Table 1.**

Table 1. pH values for selected album pages.

Album/Mounting Page	pH
Scott Specialty	8.0
Harris (Blank Page)	7.8
Can. Wholesale Supply	7.0
Gibbons	6.2
Leuchtturm	6.2
Lighthouse	6.1
Scott (Blank)	6.0
White Ace (Supplement)	6.0
Davo	5.9
Grossman	5.8
Minkus	5.4
Schaubeck	5.3
Ka-Be	5.3
Whitman	5.1
Lindner	5.0
Harris	4.9

The data in Table 1 are now old, and the study needs to be repeated. The conclusion from the study was that while a pH of 7 is ideal, any papers with a pH of 6, or 7, or 8 would be satisfactory for use with our stamps. Some conservations would find a pH of 5.3 acceptable.

The important issue regarding the pH of album pages is that we need to be aware of what the pH is for pages we use. The pH of a paper can be determined in the laboratory, but an alternative is a pH pen, with which, from its mark on a paper, one can measure pH. Abbey Publications, 320 East Center Street, Provo, UT 84660, U. S. A., markets such a reasonably accurate pH pen.

University Products Inc., 517 Main Street, Box 101, Holyoke, MA 01041, U. S. A., sells a pH pen which is excellent for distinguishing the acidity or alkalinity of uncolored papers above or below pH 6.

Light Impressions Inc., 489 Monroe Avenue, Rochester, NY 14607, U. S. A. sells a pH pen that is a good indicator of whether or not deacidification of a paper is needed.

It should be pointed out that as paper ages, the acidity level can increase slightly. Papers with an alkaline or calcium carbonate reserve will show a drop in pH value but will still neutralize acids as they form. Some available acid-free archival papers are buffered with up to 3.5% calcium carbonate. This allows for migration of acids from other types of low grade ground wood fibers in materials such as newspaper clippings. Over time, an acidic paper in contact with an acid-free paper will transfer acid by migration to the acid-free item, discolor it, and ultimately destroy it.

The acid content of a given paper is important, but also important is the paper in contact with it. In this regard, one must be attentive to the pH of file folders and the like. It has been demonstrated that an acid-free paper can be folded and open up to 400 times before breaking but, when housed within a low grade acidic folder will break after only 10 foldings.

Alkaline buffers can be added to papers to preserve them. A single treatment will not only neutralize the acids in the item you are treating but will also leave an extra alkaline buffering capability in the item. Several varieties of such sprays are available from Archival Resources (Canada) Ltd., Post Office Box 2506, Station D, Ottawa, Ontario K1P 5W6.