CRYSTAL CARD CHRONICLES PART I

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ABSTRACT: Avalanche work is the mother of necessity. Innovation and invention have been hallmarks of the cross over between the science of snow and the practicality of avalanche hazard assessment and mitigation. There are numerous simple field snow tools that have become ingrained in our regular use. This paper and poster highlight the origin story and history of two of the tools: the crystal card, which is core if not mandatory for students in the professional avalanche education stream as well as avalanche workers; and the snow specific field book.

KEYWORDS: grain form, snow crystals, field book, snow profile,

1. INTRODUCTION

Take a look in your snow observation kit, what's there? What have you been taught is essential? What do you use on a regular basis? Expand the inquiry to the rest of the tools you use in snow structure and instability observations (shovel, saw, probe, cord, etc.). Have you ever wondered about the story behind them? This paper is the first entry in an on-going project to capture and share the oral history of tools we use in avalanche work, specifically it looks at the snow crystal screen (crystal card) and the field book used for recording observations.

1.1 Setting the stage

A lot of "influencing" was happening around the N. American avalanche world in the decade leading up to 1980.

- Snowbird – USFS avalanche safety responsibility transferred to ski patrol (1971).
- Whistler patrol receives first transceivers (1973).
- Powder Magazine Vol. 1 Issue 1 (1973).
- Ramer AT binding (1974).
- Handbook 489 published by USFS (1976).
- Warren Miller's 7 Days in Paradise Mike Wiegele Helicopter Skiing (1980).
- Voile Tele binding (1980).

The potential energy was building for the escalation of powder skiing and engagement with avalanche terrain. Many of the fundamental tools we use today were formulated and refined during the overlap of the decades of the 1970s and 80s**.**

1.2 Expert snow grain identification

Why are we so captivated with viewing and identifying snow grains? I think the answer is a bit philosophic. Most seeking to understand avalanches reach a point where they see far more uncertainty than certainty associated with the topic. Snow grains are something solid, tangible, observable, and fit with our human desire to name everything. When it comes to snow grain identification, we seem to seek an island of certainty, to become steadfast, remain stoic in the face of uncertainty. There is likely emotional comfort in saying this is a fact, this a spatial dendrite, this is a capped column, with confidence, a marker of expertise. It's probably helpful that specific grain types have been associated with the development of avalanche conditions, so there is an importance associated to "getting it right".

2. SNEAKING A LOOK INTO THE SECRET LIVES OF SNOW GRAINS

Figure 1. Ski patroller examining snow grains using a hand lens and the Snow Knowledge Crystal Card.

Some type of pocket microscope has been a recommended tool from the start of modern snow grain observation (Seligman, 1936; National Research Council, 1950; LaChapelle, 1969, Perla and Martinelli Jr. 1975) as part of avalanche snow study.

Seligman (1936) found that black cardboard allowed grains to melt too fast for photographing. He then crafted a "refrigerating apparatus", an aluminum box filled with a freezing mixture of snow and salt with the viewing surface painted matte black.

A graduated cup with a flat bottom on which engraved concentric circles one millimeter apart was used for measuring grain size according to the National Research Council in Canada (1950).

A millimeter grid is shown in figure 85 of the Avalanche Handbook 489 (Perla and Martinelli Jr., 1975) as part of optional equipment for snowpack observations. It's possible the screen in the Handbook photo was the same Swiss sourced screen that was provided as part of the student kit in the British Columbia Institute of Technology – National Research Council Level 1 avalanche course. This card was later manufactured and supplied by SEAR.

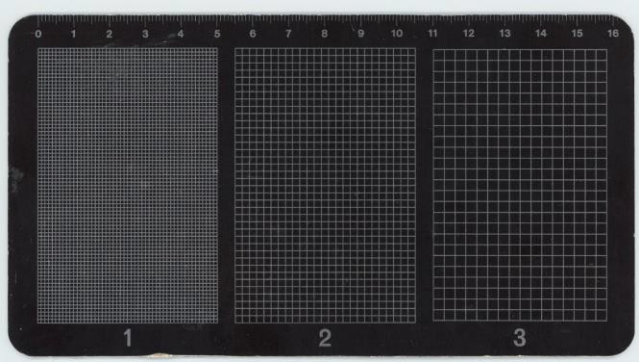

Figure 2. Early SEAR snow crystal screen.

Measuring average grain size to the millimeter using the screen is described in the avalanche course notes (BCIT, 1978). These directions are reflected in the document (NRC, 1982) which formed the basis of the CAA Observation Guidelines and Reporting Standards (OGRS).

U.S. handbooks (NSPS, 1957; Perla and Martinelli Jr.,1975) defined grain size terms: fine (<1 mm), medium (1 to 2 mm), coarse (>2 mm), and depth hoar (3 to 10 mm). Other standards (NRC, 1950) differed slightly: very fine (0 to 0.49 mm), fine (0.5 to 0.99 mm), medium (1.0 to 1.99 mm), coarse (2.0 to 3.99 mm), very coarse (4.0 mm and larger). Though Avalanche Handbook 489 includes the terms in observation definitions, the snow profile data example records actual size ranges.

It's interesting to note that none of the images of snow grains in the USFS Handbook as well as other period references (Magono and Lee, 1968) have background grids. Millimeter grids can be seen in some grain photos in others (LaChapelle, 1969; Sommerfeld, 1969; Perla, 1978).

3. CREATING A TOOL – CRYSTAL CARD DESIGN THINKING

This leads to 1979 and a keen young ski patroller (me) in the intermountain snowpack trying to learn everything possible about snow and avalanches alongside my colleagues with similar goals. (During my rookie season, my team leader had told me I had an itchy swelling brain when it came to snow and rubbing a little PreparationH on the temples would solve the problem.) Faced with what I perceived as a complete lack of available equipment, I began building what I needed. The first prototype consisted of graph paper that I took to the ticket office and laminated in the season pass machine. Enthusiasm of my patrol teammates for the prototype crystal card pushed me further. I came up with a company name and began sourcing materials to build them in a suitable manner.

One thing I noticed right away was how printed grids got fuzzy and interfered with the observability of the snow grain as soon as you looked using magnification. My background as a photogrammetric cartographer led me to looking at engineering drafting products (remember this was during the waning analog years). The first run of the Crystal Card used a clear mylar film with precision millimeter black grid that stayed crisp when magnified. It also provided back lighting. I added a graphical reference to half the card area showing the UNESCO/IASH/WMO (1970) standard symbols for common snow grains and the layer hardness (something none of us could remember). Thus, the see-through, translucent, back-lit Crystal Card was originated. I had concerns that the laminated plastic around the precision grid would get scratched through normal use so two things were done to address this: a) instructions mentioned using the non-gridded end when slicing down the snowpack, and b) the creation of a "professional" model that came with a wool felt pocket. The pocket was on a neck lanyard to allow for combination with a hand lens or loupe and an ingenious design that allowed for the card to be taken out easily for use. A "tourer" model was available without the pocket. It came with use instructions that included how to perform and record the simple hand hardness test.

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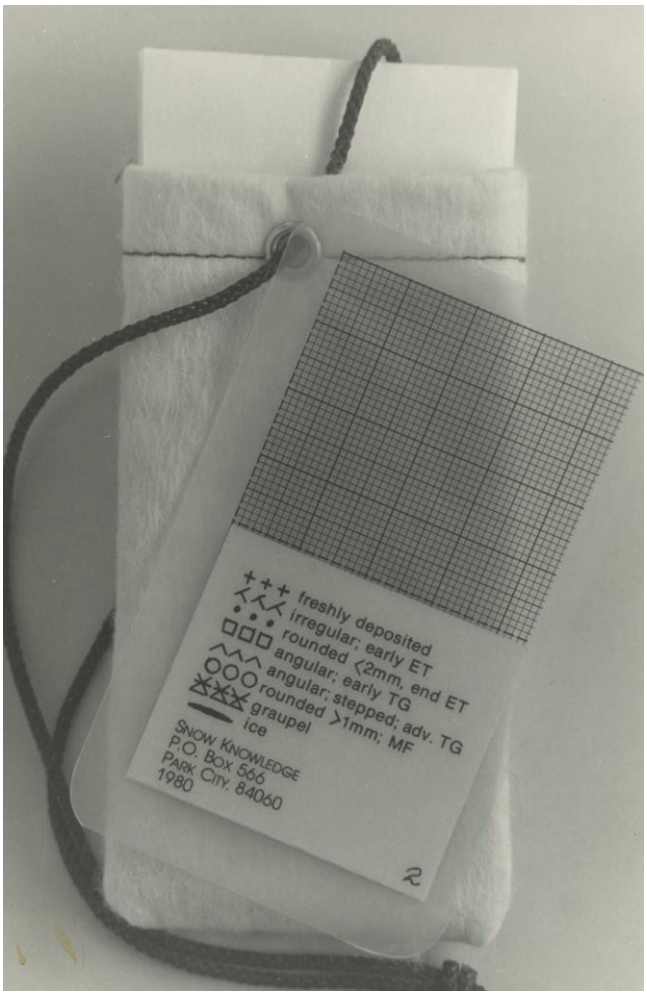

Figure 3. First run of “professional” model.

The next and all subsequent production runs utilized a film negative of the precision grid where the millimeter grid was clear with black between the lines. This created an excellent viewing and measurement background for snow grain identification.

The material and minimal mass of the Snow Knowledge Crystal Card made it thermodynamically effective. Grains remain unchanged on the card without ambient temperature or conductive heat influence for a period adequate for careful observation and classification.

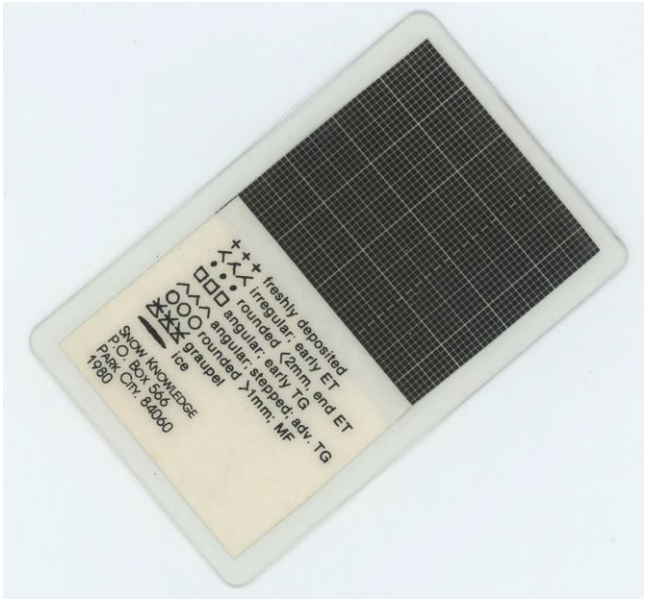

Figure 4. Snow Knowledge Crystal Card with precision clear grid lines in black film.

4. WRITING IT DOWN IN A FIELDBOOK

Creation of the Crystal Card led to development of a snow profile record keeping system. At the time, the standard field book was the J.L. Darling “Rite in the Rain” purchased at land survey supply houses. A weatherproof, snow profile specific was imagined. It used the same weatherproof paper that the “new” climbing route descriptions incorporated. It’s size (4.25 x 5.5 inches) fit nicely in a standard jacket or shirt pocket. A standardized graphical plotting of a snow profile using hand hardness had been adopted in Canada but had yet to make its way to the US. A novel isometric layout capturing the representation of test results or fracture line profiles as an inclined snowpack or isolated column. A “fill-in the blanks” template simplified recording as well as ensuring capture of consistent observations (weather, aspect, incline, etc.).

Instructions on how to dig a snow study pit (including the shovel shear test) were printed inside the covers and an example of completed observations included on the back cover. A shelf binder for storage of up to 6 Snow Study Field Books rounded out the record-keeping system.

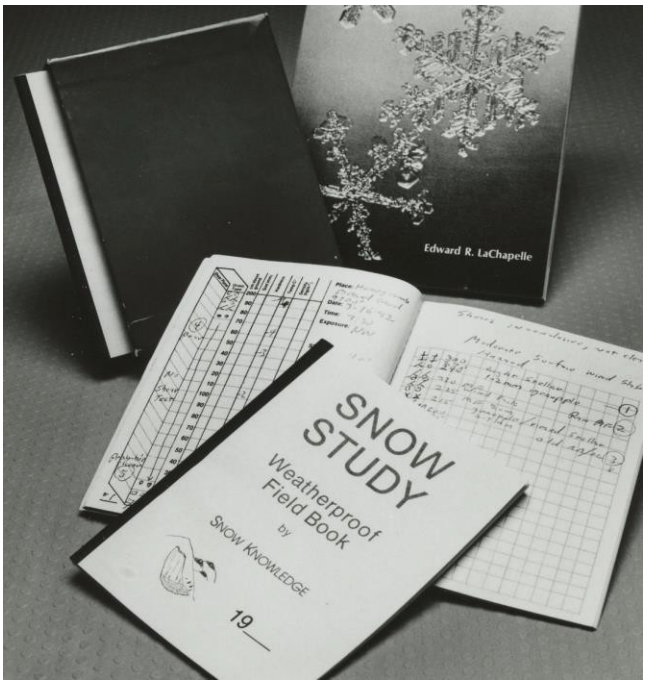

Figure 5. Image from 1st catalog of the Snow Study Fieldbook and storage binder.

Around the same time, Chris Landry (1981) first published a snow specific "Rite in the Rain" based field book. The Snow Journal – Avalanche Forecasting Workbook included pages for monthly time profiles as well as snow pit pages.

5. EVOLUTION, HUBRIS, AND MARKET TRENDS

The initial offering, the Crystal Card was directly marketed to those organizations and individuals who received the monthly newsletter (The Avalanche Notes) from the USFS West Wide Avalanche Network put out by the Rocky Mountain Forest and Range Experiment Station in Fort Collins (This was pre-Avalanche Review).

Snow Knowledge's first catalog came out in 1980 incorporating the field book and an expanded offering of other specialty snow study tools (Bausch & Lomb hand lens, Taylor dial-stem and minimum-maximum thermometers, Lufkin folding ruler, Suunto clinometer, Silva Ranger compass, and LaChapelle's Field Guide to Snow Crystals). A rescue or "Alaska" shovel was added in 1981.

Following the release of the Snow Knowledge crystal card others became available incorporating some type of slope incline indicator (The Mountain School, Winter Engineering). Life-Link offered a few styles while they were an independent company (metal and lightweight plastic ones) as well as a matching winter backcountry travel card.

Functionality versus production costs were a hurtle, one couldn't just increase the number of pieces of plastic getting inked like other offerings. Each Snow Knowledge Crystal Card was hand built in several distinct steps and individually numbered. They were meant to be a robust and precise snow study instrument. The clarity of the grid and the translucent quality of the through lighting was a trademark of the card. The card sold for what was akin to a 2nd or 3rd year ski patroller's hourly wage in 1980.

It seemed that every avalanche professional had purchased a Crystal Card as the sales success of the direct mailing was 90% plus and volume dropped after three years. Rod Newcomb (1984) indicated that his avalanche course enrollments were dropping off as well. I'm not sure if it was hubris that avalanche workers would remain as such their whole career and the market was saturated, or naivety of the likelihood of the market turning over in a few years; regardless, a natural transition to other avalanche interests ensued.

The Snow Study Fieldbook ran head long into the digital age. A letter from Ron Perla (1981) suggested future revision by "changing the format to be more compatible with computer input formats," that he expected increasing numbers of field workers in Canada to use computer prepared plots, files, etc. It also suffered from a design error, the graphic profile template was laid out based on my penmanship which reflected precise hand draftsmanship and was much smaller than most people's field note hand writing.

Gary Walton started printing a small format booklet that met the developing Canadian National Research Council data standards. He formalized this as a product offered by his company SEAR Search & Rescue Equipment Ltd. One could order field books for recording standard weather observations, snow profiles, avalanche occurrences, or a combination. He adopted the sophomoric line art of a slab avalanche that I had drawn for my first direct mailer and put it on the cover of the SEAR field book during the mid-80's. This was something he and I shared a good laugh about during his later years.

The Canadian Avalanche Association Training School (CAATS now known as CAA-Industry Training Program) used the original SEAR style field book until the late 1990's when the course field book switched to "Rite in the Rain" format containing recording template and reference pages.

Snow work specific field books didn't return to prominence in the U.S. until 1997 when Ian McCammon and

Halsted Morris simultaneously and separately published the All-Weather Avalanche and Snow Profile Field Notebook (Snowpit Technologies) and the Backcountry Skier's Field Book (Hacksaw Publishing) using a "Rite in the Rain" format.

6. THE MODERN ERA

There are a few snow grain screens available today, notably two from Backcountry Access and one from Snowmetrics. The Snowmetrics card is 3 mm thick, 10 x 15 cm translucent blue plastic with a 2 mm grid laser etched on the surface. BCA offers a similar sized translucent blue polycarbonate card with a 2 mm grid printed on it. A 1 mm thick, 10 x 15 cm aluminum card with 1- and 3-mm grids and snow grain symbol reference printed on one side, a centimeter scale and contour interval slope scale printed on the other is also still part of BCA's catalogue.

Measurement grids have been printed on other tools currently available such as the G3 Bone Saw, BCA 35cm Snow Saw and Tindeq Snow Saw.

7. BACK TO THE FUTURE – SUBSEQUENT STORIES

There are many other stories to add to this history. An example is the machined accessory developed and sold by John Simms to screw two ski poles together into an avalanche probe – the Life-Link. The thread leads to other pioneering products or tools and the associated company stories such as Wasatch Touring (shovels), Snow Research Associates (custom lathed ramsondes), Hydro-Tech (Taylor/LaChapelle density kits), and Strong Stitch (density gauge, folding snow saw).

As this paper and poster are the first of an oral history project, please forward any corrections, additions, or anecdotes to corresponding author. The project archive can be found at http://uncertainavalanche.com.

ACKNOWLEDGEMENT

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