As noted above, the steep streams along the east side of Perry Ridge have deposited fans on the benchlands. These fans consist, in part, of debris flow deposits. A debris flow is a rapidly moving (several metres per second) mass of viscous material—a wet mixture of mud, sand, stones, boulders, and woody debris—that moves down an open slope, or a gully, or a steep stream channel. Debris flows are commonly initiated by the sliding of weathered rock or loose soil on steep hillsides (debris slides).

At Perry Ridge, debris slides have occurred (and will occur naturally in the future) on steep slopes alongside the streams. Slide debris mixes with stream water, generating debris flows which descend the stream channel and then spread out on the fans. Residences are located in the potential runout zones on the gently-sloping fans. Although the flows lose momentum as they spread on the gentler slopes, the impact on a building of even slowly moving boulders can be devastating and life-threatening. Even fine-grained debris can partly bury or fill-in houses and other structures. The potential runout zones are difficult, and may be impossible, to define with any degree of reliability. AGC believe that debris slides and debris flows are potentially the most damaging and life-threatening of the various landslide types that they mapped along the lower slopes of Perry Ridge (upslope from the benchlands). Following his stream channel survey, Chatwin noted that debris flows are "common historically" in the Perry Ridge watersheds.

As typical of fans in general, abandoned stream channels can be found on Perry Ridge fans. Reckoning the normal lateral instability of streams on fans. Such a stream usually changes its course abruptly during a flood, taking up a new, hard-to-predict location: an obvious potential hazard.

*Potentially Increased Hazard:* Debris flow hazard will be increased if logging or road construction takes place on steep slopes upslope from creeks that have a constant steep gradient down to the fan. (Current logging plans exclude much of the steep, unstable and potentially unstable slopes, but the reliability of the stability mapping, which dates from 1985, is poorly known.)

**Other Hazards:** river bank erosion; changing stream courses.

**Sources of Information**


Consultants reports completed for M. Benedict and A. Greengrass.

J.M.Ryfield observations, July 18 and 19, 2000, and discussions with Muffin Benedict and Marilyn Burgoon

J.M.Ryder  P.Geo.

September 16, 2000
Dear Ms. Sawicki:

Follow-up to meeting re Perry Ridge Area: Considerations Regarding Geo-Hazards

I appreciate the time you gave to meeting with us on Monday (Sep. 18), but because the meeting was so short, I came away feeling that several matters require clarification. Hence this letter.

Early in the meeting, you indicated that your Ministry staff and others had told you that ‘both sides were so entrenched that there was little hope of reaching an agreement’. I do not feel that my professional opinion is ‘entrenched’. Rather, it is based on information gained from reports, discussions, air photo interpretation, field observations, and previous experience.

My interest in the Perry Ridge area was initiated when I was asked by the Perry Ridge Water User’s Association to review recently completed reports on the terrain and geological hazards of the Perry Ridge area, particularly the bench lands. During the course of this work, it became apparent to me that the current activity of geo-processes here is unusually intense, and that the residents need professional help. My concerns about the area led me to visit for 2 days in July (on my own initiative and at my own expense), when Muffin Benedict and Marilyn Burgoon showed me many intriguing (to a geomorphologist) examples of the effects of recent/current geo-processes. Piping seems to be particularly active here, leading to my statements regarding the uniqueness of this area. Landslides, debris flows, stream floods, water diversions and river bank erosion also threaten private property, roads, and people.

The degree of geo-hazard and risk is unusually high for an area with a relatively large population, and locally extremely high. There has been no appropriate hazard assessment, and as far as I am aware, no land use zoning or other restrictions on land use.

In yesterday’s meeting you pointed out that it is not unusual for people to have to live with risk, and so this point alone is not of unusual concern. This is true, but the degree of risk at Perry Ridge is already unusually high. This is in large part due to natural circumstances and, to a lesser extent, due to poor land use practices by a minority of residents. The perception of high risk by the local people is based, quite legitimately, on their awareness of the damage already done to nearby homes and property. In areas close to Perry Ridge, they have found landslides blocking roads that they regularly travel, they know of many cases in which landslides have followed logging, and cases in which people have been injured or killed by landslides.

The fact that the residents continue to live on the Perry Ridge benchlands is itself an indication that they are willing to accept a significant degree (in places a very high degree) of risk. This is their choice. With regard to the proposed logging however, they are not willing to accept an increase in the already high risk imposed against their will by an external agency, when the potential rewards of accepting the additional risk appear to be negligible. Even if the Ministry of Forests’ financial prediction is correct, a profit of about $900,000 over 1 year will likely be more than counterbalanced by the costs of damage to private property, which have not been factored into the analysis. Neither have the costs been included of additional hazard studies.
I have grave concerns about several aspects of the potential effects of logging the Penry Ridge uplands. These include the following:

- Operational plans for logging are being based on terrain mapping that was carried out in 1985, prior to the establishment of both the RIC standards for terrain mapping (1996) and the standards for terrain stability mapping in the Forest Practices Code (first edition in 1995). Although this mapping was “upgraded” to the current stability classification by a paper exercise, there was no rigorous check of original mapping and its quality is unknown.

- Present logging plans are conservative, but based on what is likely a false assumption that removal of a relatively small amount of timber (15% ECA) will have little or no effect on stream regimes. In fact, the effects of both tree removal and road construction in the small, steep basins are likely, during particular weather conditions, to generate high runoff that will result in significantly increased peak flows.

- Even the most careful planning of roads and cutblocks cannot guarantee that accidents (slides, debris flows, floods) will not occur. A single such event on Penry Ridge, where steep slopes and steep creeks descend to highly sensitive terrain with dense rural settlement, could have disastrous effects.

In view of the above, together with information provided to you on Monday, I see no justification for logging on the Perry Ridge uplands.

Yours truly,

J.M. Ryder  Ph.D., P.Geo.
I have been asked to respond to your letters dated July 28 and September 20, 2000, to former minister Joan Sawicki, regarding the geological risks associated with logging on IDI below Perry's Peak.

For the most part, the Ministry of Environment, Lands, and Parks (MELP) does not have jurisdiction in the matter of logging! The decision official that approves forest development plans (FDP) outside of community watersheds is the manager of the Ministry of Forests (MOF), McFadyen Creek. The one community waterbody within the planning area. In this watershed, MELP and MOF jointly administer FDPs. The total chance plan indicates there is only a very small area that may be affected by logging on Crown land. In this McFadyen Creek watershed, there is not a FDP proposing any logging in this watershed, the regional water manager, as the MELP designated official, will analyze the public safety question along with the MOF district manager.

In both your letters, you describe natural hazard soils that affect private lands along the east side of Perry's Peak. In your first letter, you conclude that prior to any forest entry, it is important to consider the potential for logging in the valley floor east of Perry Ridge, there should be an investigation of the hydrologic linkages between the lands and existing hazardous conditions. A scientific panel (Boyer, Jordan, and Willard) prepared this report for the Perry Ridge Local Resource Unit. The panel examined the small watersheds and identified linkages between the areas at risk on the valley floor and areas with potential for logging; i.e., areas identified in the total chance plan.

One approach, which you
diJC-8 in YOIt letter. is to undertake all extensive drill program to IIlM>out possible subsurface flow paths. This would be very expensive IIork would not necessarily provide sufficient info to adequately track subsurface flows. The other approach, the one chosen by the p-I, is to map the surface flow paths on the ground and limit the risk of impacts by limiting the amount of tree removal and requiring extra care when lvestinl: timber and when placing building and using road~.

I am further advised that the risk assessment report identified three hydrologic units with high sinkhole and landslide potential. For two of these units, the LRUP would recommend no development. This left one unit, Jetone Creek, as the only high-risk area possibly affected by logging. The planning table adopted recommendations limiting the rate and method of cutting timber and required detailed professional assessments and Code plus practices for this area. The risk assessment report also identified five hydrologic units with half of sinkhole and land~uses. In the creek units, recommendations were made to specifically line the hydrologic linkages of surface flows and apply the IS pertinent equivalent collllICutarea CECA) limit.

In your survey letCl, you list three concerns with the potential effect of logging. ItIIS stated that you see no justification for any logging on the Perry Upland uplands. One of your concerns is that operational planning for logging are being based on terrain mapping of unknown quality. I have been informed that the mappers was checked twice and judged to be adequate by the MOF. The first check was a general assessment of all the 1980s mappping in the Slocan Valley, undertaken by Peter Jordan, MOF (geomorphologist, axial Kim Green, master's Earth Scientist. The second check was performed by consultant Steve Chatwin. He colluded that the original mapping was adequate based on his field traverses of lb. ridge: during channel assessments and other mapping, and a review of the air photos.

Another of your concerns is that the present logging plans are essentially the same as in the past. You state, Min fact, the effects of both timber removal and road construction in the small, steep basins likely, dillving partkahir WSalch conditions, to increase high III10fflat will result in Blllll811111Y increasing peak flows. However, oil review in the available research on the subject. IM PRRAR found that measurable eff~ & on streamflow are Ulllllly at less !bill!20-percent-ECA, In addition to llnIItna the amoWll of tree removal and road building, the...
PRRAR iiId the LRUP IIbJe have recommended further Idles in areas identified as having a high risk of impacts from logging. These studies will require detailed field assessments by professional engineers or geoscientists. The district officials will have to consider these recommendations when approving any FDP.

Finally, you state your concern that even the most careful planning of roads and cutblocks cannot guarantee accidents (collisions, debris flows, floods) will not occur. I agree. Your comment, however, applies to most areas in the Kootenays and much of the province. If 10% were to be curtailed in this area for this reason, then why would it be allowed in many other populated rural areas? It would not be sensible to exclude all logging opportunities over such large areas. The sensible thing to do is to identify the risk and mitigate the risk using suitable procedures and best practices as is being done on Perry Ridge.

I understand that the Arrow Forest District and others are trying to organize a workshop and meeting with all the professionals that have been involved in the risk assessment. You would be most welcome to attend.

Yours truly,

Robert Roberts
Executive Director
Regional Operations and Environmental Assessment

cc: Brian Simpson, District Manager, MOF, Arrow Forest District
Dear Mr. Roberta

Thank you for your letter of November 23 regarding activities with logging at Perry Ridge. I have forwarded your letter to former Minister of Environment Joan Sawicki, to which I would like to reply: I apologize for being so slow in doing so.

In paragraph 2 you note that MELP does not have jurisdiction regarding logging on Crown Land at Perry Ridge. It is my understanding that MELP has no jurisdiction regarding logging matters as the Invl, om 81 threatened. The Environnental Management Act Section 4 gives the minister, the polWtr as Per) ridge, out of the area. "The minister may, in writing, declare that an existing or proposed work, undertaking, product or resource use has or potentially has a detrimental environmental impact. Section 5: "If a declaration has been made... the Lieutenant Governor in Council may after notice, but without the necessity of holding a hearing... make an order... restricting, modifying or prohibiting the operation of the work or undertaking... in any way... limited to the gently sloping benchlands of the Perry Ridge area. The benchlands are formed by thick glacial lake sediments which are slowly permeable, and glaciofluvial sediments which are more rapid permeability. The plills of groundwter will be influenced by thick glacialic sediments which are slowly permeable, and glaciofluvial sediments which are more rapid permeability.

In paragraph 3 you note that the PRRA map and the polygonizing M tA geological hazards maps (Geological Consultants) are quad inadequates for the purpose.

In paragraph 4 you note that the PRRA id0ttified "hazard" hydrologic units with "a high risk of sinkhole and valley-bottom landslides. Only two o'f the hazard areas at Perry Ridge are recommended for 1.0
d.Y.1QPme~t; _ Creek ... maino as a high rl.k rN thel could potentially b-- ncted by logging. Yet the hazard to local ""Idenl" - u. to piping and landslides is extreme In Illa! part 01 m & Jerome Creek 'zonB of Inhane.' 111.1 have examined on Inh ground. Even with the very con.1 MUIUce forest practices Illa! you mention, I do not believe it ls possible auminate t-- rext of IllcCldD~"luch a8 Gould hml dramatic impacts in the residentia' ar.as do &Wn.lope. Also, I have be.---advised th- the standard ""Cave tables"" had been used lo the, .lsk an.osment, (hina and ollll\ areas would have been zoned for 'no development'. [In tha Cave mol ., return periods 01 1-500 yr Ifr ... igned a "no development" status., whereas in the PRRA, raWrt perloO. of up 10 OOr.: . r6 osaimgd 8 "very low hazard"

The laIDmen" that I make ln parlerap/1 6 are b--- d 00 the ""pert opinion 01 Dr. M. eMureh -- the Urve. ...lY Of British ColurT'bl, a hydologist who hiil l allO extensively reviewed available re8eereh on tNs subjec & Whose advieo _ froqUB!B"lly Bought by sllff of ME~P 811(Mof.

With to~.rd to your paragrapn 8, wOe" you quesllon the r,eetj for speelsl treltm!lnt al Perry la9dt, I refer you to rny COI'
(2 pal. graphs) about Piping in the July 28 letter, end to my ...ply to a comment of Ms. SawICl<. tna' was very similar to yours (~th pa1l'gr.ph i~ my Septeml'>r letter):

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I\S fana . am llw.re. tNa 8feaa l, unique within (irtj-h Columbia wth fe.pect to tile suilnmt high piping activity. ehto-h rolld piping landforms are widespread ol.crtrh&re on gbscial lah .t..aocl and example8 0f pronounced coUap.. have been reported. At prestal, we do not knoIf the 10C8 piping activity has b'un c-c-rietted by changes In sllt\urlCl drainage (diz;"haril8 volumes, regime, pBlhwayGaa.oicolated with chsn& it ...4t h.l.loriC tan; u... or vegetaion (t."., road construction, ret r&m-... wldflir,. ree.id6nUalYclopnpmfIlr).

(July 28)

The filet that the relmenls conUnue 13, Nw Ot the FEHry Ridge b&nctJand.I It ITUIt an\idioallotl that they art wiring 10 accePl a signifie:tlit degree (in pieces ~ Yerh high degrcm.) or alil. ThiS is tlltr, in cholel, wth r referi to IM prop01J&JItl <OWN however, the-Y 819 not willing to letrUal an "ere., In the .YNCly high risk, ImpoSSc:tagsin their wt by an 6[tem41 agency - e.splclicly wMn th. pot8i0el mwar06 of OOPiping the clik/tuonat n"ot 6PPlar to be n.-/gbJle. E-en if tr:e Minl.ry of Forest' time/esi prediciOon 1, consider a profit of about 000 over 10 year. will l.ility be more than counterbalancd b) IV: cast of aamage to prin-laliUld public property, which I1M n"ot be foun 1.9rtorCl into the eueJ/sb. Neither have the C-OSt1bbl"fineludbd of additional hazard atudie&.11 (September 20: iiIllic-sand bldl not --- me at 7Tig1neker)on

1/conolu.ion, I think th.t the planhed logging on the Porry Ridge upload e--- very rea' and consider.bl. rl.ka to IDme of the reskUnro on the benenlendo down-lOp" n.1<s hat hav8 yet to be fully apPrecllted by the government 3Q8110iesinvolved.

Yours truly,

J.M.Ryder P.Geo.

c.c. : Mr. Brian Simpson, District Manager, Arrow Forest District, B.C. Ministry of ForestrI Mr. Dwayne Boyer, Engineering Section Head, Water Management Program, MELP, Nelson Mr. Howard Kushner, Ombudsman, British Columbia Mr. Muffin Bencidi, Resident, Perry Ridge

1 A revised cost benefit analysis indicates this figure is $200 000.
Dear Dwain:

I have discovered what could be a serious potential hazard at Perry Ridge: several residences may lie in the path of a possible rock avalanche. (This is a natural hazard unrelated to forestry activities.)

A slow-moving (or formerly slow moving but presently stationary) rockslide (slump) consisting of slump blocks and broken rock (disintegrated slump blocks) is located between 1000 and 1300 m (approximately) elevation about 1 km east of Newcomen Creek (see attached map). Slide debris extends downslope to the top of a cliff where large blocks and some semi-detached rock pinnacles appear poised to tumble down slope. Some rockfall has already occurred, forming a talus slope (red arrows on map).

No clear evidence of present recent movement is apparent from air photo interpretation. As far as I can tell, the scattered trees in the slump area are mostly vertical (I can see very few tilted trees); no freshly disturbed (i.e., paler toned) rock could be seen. However, the position of this large mass of incoherent rock at the top of a very steep slope suggests that a major rockfall or a rock avalanche could occur here. There are several dwellings immediately downslope, so the potential hazard to human life could be high.

The feature can be seen on colour air photos BCC 96051: 106-107 and BCC9B052: 006-009).

I recommend that a thorough ground inspection of this area be carried out by an experienced rock-slope stability specialist in order to assess the likelihood of catastrophic slope movement, the extent of the potential runout zone and the hazard to local residents; and to make recommendations about remedial measures if necessary.

Existing terrain mapping shows this feature, incorrectly, as a talus slope affected by rockfall.

I would be happy to discuss this with you, although the only information I have is from air photo interpretation.

Yours sincerely,

J.M. Ryder  P.Geo.
September 14, 2001

Dear I.M. Ryder,

Re: Rock Avalanche Hazard - Perry Ridge Area

As noted in the correspondence from Dwain Boyer, P.Eng., I have received your correspondence of July 16, 2001 regarding your concerns for a potential rock avalanche in the Perry Ridge area of the Slocan Valley.

The Ministry of Transportation is responsible for review of natural hazards that may affect numbered highways. The potential hazard you have identified would likely not impact Highway 6 located across the valley from the site and consequently would not warrant a technical review from our staff. However, our Ministry is responsible for determining if natural hazard assessments are required for proposed subdivision in an unincorporated area. I will forward your concern onto Peter Muirhead the Ministry's Provincial Approving Officer, who will require a 'natural hazards assessment for any proposed subdivision in this area; facilitating further technical review of the site.

Sincerely,

Mike Walsh, P.Eng.
Manager, Geotechnical & Materials Engineering
Kootenays Region
Ministry of Transportation

Cc: Dwain Boyer, P.Eng., MoWLAP
    Peter Muirhead, MDT
    Dave Wahn, Regional District of Central Kootenay
Statement: Risk Assessment and Geological Hazards, Perry Ridge Area

General
Prior to any forestry development on slopes that drain to the terraces on the valley floor east of Perry Ridge, there should be an investigation of the hydrologic links between the uplands and existing hazardous conditions on the valley floor. Such a study should address the nature of the hydrologic processes (water discharge, regime and flow pathways, both surface and, especially subsurface) and the potential changes to hydrologic processes that could result from land use and vegetation changes.

More Detail
For the residents and properties on the terraces west of the Sicamous River, the chief hazard is erosion by underground water (piping) in fine-grained glacial lake sediments and adjacent soils. This is an actual, not a potential, hazard. In many places, both recently and during the past few decades, piping has resulted in sudden collapse and/or rapid subsidence of the ground surface and the development of gullies and collapse depressions. As far as I am aware, this area is unique within British Columbia with respect to the current high degree of piping activity, although relict piping landforms are widespread elsewhere on glacial lake terraces and examples of ground collapse have been reported. At present, we do not know if the local piping activity has been exacerbated by changes in subsurface drainage (discharge volumes, regime, pathways) associated with changes in recent or historic land use or vegetation (e.g., road construction, tree removal, wildfire, residential development).

Landslides are also a significant hazard in this area. Like piping, they are strongly influenced by subsurface water, and any increase in subsurface water flow could result in increased instability. Inasmuch as piping erosion may create zones of weakness in the ground, it could also give rise to instability.

The standard process required by the Forest Practices Code (terrain stability mapping input to operational planning) does not (as far as I am aware) address the nature of the links between the effects of upland forestry development and potential impacts due to piping outside the mapped areas, such as piping on the valley floor terraces. Some impacts outside the area mapped (e.g., downslope runout of debris slides) may well be recognized and taken account of as a result of terrain stability field assessments, but these are usually done after roads and blocks have been laid out, at a time when operational plans are almost finalized. More importantly, it is unlikely that even the most experienced slope stability specialist would recognize potential groundwater hazards so far removed from the inspection site.

* follows from the foregoing that my recommendation is for a study of the hydrologic links between the Perry Ridge upland and the valley floor terraces. This should be done prior to any land use decisions for the upland. Until the study is completed, the addition risks to residents and properties already affected by piping that are posed by upslope forestry activities cannot be assessed.

Certain aspects of this study, such as a compilation of the history of ground collapses (to compare with land use/vegetation cover changes), monitoring of water-level recorders, and other observations could best be done by local residents. Thus they (Perry Ridge Water Users Association) should be involved in both the planning and operational phases of the work.

Dear Mr. Harrison,

In August 1997 my wife and I spent 10 days looking for real estate in the Slocan Valley. We only considered undeveloped parcels greater than one acre and was appalled to discover that significant geotechnical concerns existed on many of the parcels we examined. In many cases it appeared to me that landowners were selling off marginal land and offering it to the unsuspecting buyer.

Section 1 of the Municipal Act and the Condominium Act require that the Ministry of Transportation and Highways, the Ministry of the Environment, Lands and Parks, and the Regional District review subdivision proposals in part to protect against development of geotechnically hazardous areas. If there is a perceived geotechnical risk, it is the responsibility of the Regional District building inspector to call for a geotechnical report before issuing a building permit.

Silty sands deposited in a deglaciated lake once filled the Slocan Valley to a depth of about 200 to 500 feet elevation. The Slocan River cut into the lake creating modern floodplains subject to regular flooding. In area, the river undercutting glaciolacustrine materials slumping and forming fans. The rapid mass movement events impact lower slope positions and the valley flat. These rapid movement events impact lower slope positions and the valley flat. Critical slump scars are widespread in the valley.

The geotechnical hazards in the Slocan Valley are summarized below:

- Rorational failure of glaciolacustrine materials, especially where undercut by the Slocan River: SIUIne is most common near the river (within 100 m). It has a visible effect on lands much farther away. Many properties were viewed which were subject to orational failure. Two examples are presented in Figure 1 & 2.
• Regular flooding: A number or parcels were vic\vcu which COrlslsled t'nlin:ly of rivt.:l
level floodplain (Figure 3). No higher level ground existed on these parcels. Exren'>IYe.: mitigation would bii!required to construct rc~idental dwelling::.; on rhcse loIS; The
construction of septic systems would he severely resrlicc(L

• Rockfall and dehTIl.1. !low hi.Iz-lerh from steep ..;;topes: Steep slopes prone In rockfall ;Illd
debis 110Vhorder the settled portl)'tIS of the SInClIlValley. \Where"-ll h:ment i" situated close 10 the base of these steep sIopes, propcny and human life may he a risk
In 1996 a house on the Slocan River West Road (Ficurc 4) was uestroved by a dchm
nw. In 1997, just sOllth of the destroyed hOllse. I n"Oted the construction ot' a new
house on the apex of an JctivC' dehris now eonc.

Asioe from direct impacts from spefic hazards, there are more w\Cil'Ssrre:lu. Inng-lenn
concerns which may -]risce h-cau."c or the lack of geotechnic:II rianillin~ in [he Sine:]n RtvFr
valley. As IIorc people scule Dillhc river-level 1inndplain. 11i: likely 1lli.1fr:\r dyking will he
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will cause progressive property loss. and may trigger r<1talion ll-lsulation ring ill
proviosly "apparcmly st-lbile" areas underlain by g.laciolacustrine mttcnals.

The conrinul.'d lack of geotechnical planning 111t1lt: Slo\c-11r.\1.T "":IIle\1II h-\vt.: ..Cil'(I):" impacts on unsuspecting real-estatt! huyer ...:Ulpropc.:rty \\WllefIS. In the: long: u...: tile
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he seriously con;."id:ed for the benefit of all rsidcnL\L:'i. and c:spccially for the long-tern
health -nJ aesthetic appeal of the Slocan River v'llley.

\Ve fcelthat a geotechnical study. rc:;.:,;.,ulting in the preparation nfg eo(cchfl1C't/ zoningm;lops. should be conducted for the SJoC:n electoral area. This mapping would be referred to hy
Ministry DFTransp11;ion:tion and Highways technic:al starr before ~rrrrnving,>udvision
developments. and hy the Region:;:D District's huiidng inspc:ctor before issuing liilidin-
ppennts. In arc-L"where geotechnical concerns were indicated the developer wntlt he
requested to conducr a detailed a\\cssment indicating potential gl:ntcchnical hazards.
covenarHzs. and mitigation stra\'e-ies.

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with our opinions. we would like he considered as a potential contractor 11h requesl fnr
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\Pierre Frick. M.Sc.
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