

April 5, 1968

Dr. Irwin Scollar  
Rheinisches Landesmuseum  
Colmanstrasse 16  
Bonn 53, Germany

Dear Dr. Scollar,

We have had an inquiry from Dr. Alan McPherron at the University of Pittsburgh about doing a magnetometer survey at a Neolithic site in Divostin, 7 kilometers west of Kraqujevac and 100 kilometers south of Belgrade, Yugoslavia. I am wondering if you are familiar with the soil conditions there and whether it would be an appropriate site for a magnetometer survey.

Dr. McPherron plans to excavate there in September 1968 and in the summer of 1969. He will be in Yugoslavia this summer, however, and will look at the site in late June. Since I am leaving for Greece on April 24th, I am writing to you now with the hope that some plans can be made ahead of time. There is the possibility that I could meet Dr. McPherron there in late June or early July to test the magnetic conditions, but I am not sure of this. Also, I do not know whether or not I could return in September. Would you be interested in doing a survey there? If I am able to return, there is the possibility of our doing it jointly. It might provide a good comparison of your differential proton magnetometer and our cesium one.

I shall look forward to hearing from you.

Sincerely yours,

Elizabeth K. Ralph

See note re Yugoslavia & McPherron

L A N D S C H A F T S V E R B A N D R H E I N L A N D



RHEINISCHES LANDESMUSEUM  
BONN

RHEINISCHES LANDESMUSEUM · 53 BONN · COLMANTSTR. 14-16

Dr. Elizabeth K. Ralph  
The University Museum  
Philadelphia, Pa.  
33rd and Spruce Streets  
19104  
USA

BONN,  
DEN 10.4.68  
FERNRUF 32158  
NEBENSTELLE

ZEICHEN S/523/68

BETR.:

BEZUG: Your letter EKR/abn, of 5.4.68

Dear Miss Ralph,

Thank you for your letter. The proposed work at Divostin sounds quite interesting. Unfortunately, I have never been in Yugoslavia and know little about soil conditions there. If you are visiting the site in June or July, perhaps you would like to take some samples and send them to me for susceptibility determination? About three weeks from receipt must be allowed for mechanical preparation and storage at constant humidity/temperature to constant weight before the measurements can be made with any accuracy and repeatability. I am going on vacation from the 15th of July to the 10th of August and afterwards must do a big survey at Xanten, about 140 km from here which will occupy me until the end of October. Therefore, if you would like me to do samples, I would have to have them by the last week in June, unless you are willing to wait until the beginning of November for the results.

I am not allowed by governmental regulations to take our measurement bus with its equipment out of Germany. It is an official vehicle which may only be used within the country. Therefore, I am afraid that it won't be possible to accept your kind offer to do a joint survey. However, if I can be of any help with the soil samples, please let me know.

For the soil samples, half a kilogram or so of material, taken at 20 cm intervals from the surface down to two meters if possible is required. One such series must come from archaeologically undisturbed ground, and another must be taken vertically through an archaeological feature of the type which one desires to map. The samples are to be packed in double polythene bags, with the descriptive

labels either typed or written with a ball point pen, placed at the bottom of the outer bag. The necks of the bags are to be folded over several times and tied securely with string. A customs declaration stating:

"Bodenproben für wissenschaftliche Untersuchung"  
(ohne kommerzielle Wert)

must accompany the samples. If you have time, perhaps you would like to accompany the samples yourself on your way back to the USA? I would be pleased to show you our labs and discuss problems of mutual interest.

Yours sincerely,



(Irwin Scollar)





RHEINISCHES LANDESMUSEUM  
BONN

RHEINISCHES LANDESMUSEUM · 53 BONN · COLMANTSTR. 14-16

Dr. E.K. Ralph  
MASCA  
The University Museum  
33rd & Spruce Streets  
Philadelphia

BONN,

DEN 22.4.68

FERNRUF 32158

NEBENSTELLE

ZEICHEN 5/

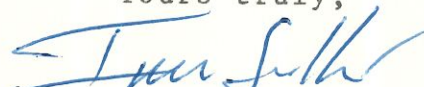
BETR.:

BEZUG:

Dear Miss Ralph,

Thank you for your reply to my letter. Surface samples will not give too much idea of the susceptibility contrasts to be expected. If a soil corer can be obtained locally, perhaps from a pedological institute, samples down to about 1,25m could be gotten easily, without digging. This is the method we usually use when nothing else is available. At least, in this way, one can get the contrast between plough layer and subsoil, giving some idea of what may be in the pits or ditches.

Yours truly,

  
(Irwin Scollar)



Kragujevac, 6 January 1969

Dr. Elizabeth K. Ralph  
Department of Physics  
University of Pennsylvania  
Philadelphia 19104 USA

Dear Dr. Ralph:

You will probably remember our exchange of correspondence last spring about the possibilities of doing some magnetic work at the neolithic site "Divostin" that I was planning to excavate in conjunction with Dragan Srejović (of Lepenski Vir fame). I'd like to let you know what has happened since then, because I think the results will be of interest to you. I didn't follow up our correspondence earlier because it appeared you wouldn't be able to bring in an instrument, and because I was unable to get soil samples to Scollar's specifications (they are rigid) before leaving to work in another part of the country during the summer.

The village Divostin is located about 8 km W of Kragujevac, which in turn is 26 km W of the "Autoput," the main road from Belgrade to Greece. The site covers an area of perhaps 25 hectares, with shallow deposits of habitation residues as close as 20 cm from the surface, and only rare instances of stratification. There appear to have been at least two periods of Starčevo (early neolithic) occupation, very poorly preserved except for pits, and a heavy Vinča (late middle neolithic) occupation. The earth matrix is a very stiff clayey black soil; it overlies a yellow partly calichefied (?) "hardpan"-like subsoil. Bone preservation is very good, but plant remains have been disappointingly rare. We used water separation on material from pits with only very meager results. Even charcoal is not common, and the charred grain found on a number of sites is absent entirely. There were other disappointing or maddening aspects of the work as well, but we did have one <sup>great</sup> big joy: we found some Vinča house-floors, burned in situ, one of them with 37 whole pots on the floor, and of course a thick layer of burned house-rubble. In addition, in several spots in each house we found some sort of oven construction with evidence of much use with fire. The houses were, as I said, burned in situ; the temperature was high enough in places to vitrify the house-rubble and pottery.

About half way through the season (which ran from early September through the first week of December!) my partner Srejović chanced to mention the Geomagnetic Institute near Belgrade, and we managed to get in touch with them, no thanks either to Srejović or the Yugoslav telephone system. The Institute's director, Ing. Radomir Turajlić, was interested in archeomagnetism, and in due course two members of his staff (with joint appointments in the Natural Sciences Faculty in Belgrade), Drs. Ranko Mužijević and Draguljub Stefanović, brought out their magnetometer for a tryout. All systems were go, the needle wiggled enthusiastically over the burned house-rubble and ovens, and we contracted for a survey of the site.

Three men came out in a Land-Rover with the proton magnetometer, a rather primitive-looking device requiring three readings at different heights above the ground at each station, with the meter readings being transmitted via Walkie-Talkie by the second man to the third man operating the monitor magnetometer, and it was decided to run a series of transects across the site, with readings at 5-meter intervals except where anomalies indicated that greater resolution was required, when readings were taken up to every meter. I might point out that I opted in favor of a random sampling of the entire area of the site, and suggested 9 readings per 5-meter square, the squares being selected with the aid of a table of random numbers. My suggestion was overruled.

In any case, a number of anomalies were located, probably representing further Vinča houses, and I would say that the method is definitely a success with the Yugoslav neolithic, and with a better site and better sampling design should be downright spectacular. The men worked for about a week and a half, and they will (have not yet) furnish us with a formal report, but it did seem to me that the \$1500 that they charged was more than I would have expected.

Samples from the "ovens" were also taken, for archeomagnetic study, using the standard technique in which declination is marked on the plaster cast and inclination recorded by levelling the surface of the wet plaster. They have not yet run the samples.

My general impression is that they are up on the literature, competent, enthusiastic, but very Balkan, and I am sure that only my repeated visiting of their really admirable-looking establishment overlooking the Danube in Grocka, the "Beverly Hills" of Belgrade, will inspire them to complete the analyses and finish the reports.

On the other hand, I am compelled to think how rapidly the work could be done and the analyses completed by automated equipment and computer processing, and how much more satisfactorily than with the 5-meter resolution that was used, and how I would like to have a crew from Pennsylvania try its hand not only on the site Divostin but also on about a dozen other early-neolithic sites that I know of that may well have similar houses, of the Starčevo period. I am interested in the houses not only for settlement-pattern study but also for investigation of social organization, in the fashion now being best practised by Bill Longacre in Arizona. I know of few other situations in the world where the prospects for such work are as promising as they are around here, although this may merely reflect my ignorance or local identification.

As you probably know I am operating almost completely on counterpart funds, a great convenience in these times of NSF faltering. In the very near future I shall be preparing a new project, and have discussed various possibilities with Turajlić of the Geomagnetic Institute: what interests me most is a project stressing the magnetic survey and dating of a number of sites of different periods, to serve the Institute in its interests in establishing a local magnetic chronology, and to serve archeological interests in site-mapping and dating.

I am not at the point of proposing anything to you, but would be overjoyed at your comments and suggestions and ideas in this regard. The Geomagnetic Institute would be interested in a cooperative

project with an American institution; the director has expressed an interest in working with DuBois of Arizona or with people from Penn. I would certainly like to see some more Western scientists and more modern equipment at work.

→ Would you be so kind and send me any offprints you have available on related subjects, including thermoluminescence analysis, and references to recent literature out of your head?

Turajlić mentioned a Dr. Nagata working with you on paleomagnetism; can you tell me anything about his work?

I still have funds available to bring you over here for the next field season in May thru July, if you are interested in seeing the situation first hand.

Incidentally the fired house-rubble is loaded with casts of organic material, and probably also contains identifiable silica. If you know of anyone who would be interested in looking at a few samples, please let me know. I regard it as an untapped source of much information.

I have not written to Scollar, but since he cannot take his equipment out of West Germany and since we already know something of the magnetic susceptibilities of the materials on the site it does not appear he could do much for us.

With best regards for what remains of the holiday season (tomorrow is Orthodox Christmas) and hopes that we may remain in contact,

sincerely yours,

*Alan McPherron*

Alan McPherron

Narodni muzej  
KRAGUJEVAC  
Yugoslavia.

*Jugoslavija*

January 14, 1969

Dr. Alan McPherron  
Marodni muzej  
Kragujevac  
Yugoslavia

Dear Dr. McPherron:

Thank you for your informative letter. Divostin sounds very exciting and perfect for magnetometers. There is a possibility that I could come there this year, probably in late June, or possibly in late May, if it is not too complicated to bring in instruments. I have two small jobs to do in Italy that I had planned to do in early June.

I am wondering about the extent of the area of search. At Elis in Greece last year, I found that I could cover 1/2 sq km in complete grids (with lines at 3-meter intervals) in 8 weeks with the cesium magnetometer. Also, do you know the magnitude of the anomalies that the Belgrade group detected? How deeply buried are the house floors? If they are quite large and not too deep, there is the possibility of using a new fluxgate magnetometer that would be even faster. I should think that there is a good chance of mapping out the whole site in the form of magnetic contours.

I am not too enthusiastic about automated equipment and computer processing because it becomes too bulky to carry around. My system is to plot the magnetic contours each evening so that the results are available the next morning. When they are all completed, they can then be photographed, reduced in size and put together on a map of appropriate scale. I assume that you have a surveyor so that I wouldn't have to lay out the grids nor create a map of the site.

If we use the cesium magnetometer, I shall need 2-3 assistants - either intelligent workmen or technicians from the Geomagnetic Institute - ones with strong backs.

Dr. Rainey, our Director, is away and he won't be back before I leave for Mexico on February 1st, but I should think that he

January 14, 1969

- 2 -

Dr. A. McPherron

would approve of my going to your site. I hope to return from Mexico by the middle of March.

For the archaeomagnetic measurements, the person whom we feel has been most successful is Ing. Dr. Vaclav Bucha, Ceskoslovenska akademie ved Geofyzikalni ustav, Bocni II - cp. 1401, Praha 4 - Sporilov, Czechoslovakia. I should think that he would be very much interested in your site and could probably come there to take samples. Under separate cover, I am sending a copy of one of Bucha's articles and some of our own.

Sincerely yours,

Elizabeth K. Ralph

EKR/mrb

February 25, 1969

Dr. Alan McPherron  
Narodni muzej  
Kragujevac  
Jugoslavija

Dear Dr. McPherron:

Thank you for your letter of 10 February 1969.

Miss Ralph is now in Mexico and, unfortunately, will not return until late March or perhaps early April. It is very difficult to reach her but I will try and send a copy of your letter to her, as I know that she is very interested in working in Yugoslavia. If that does not arrive your news will have to wait until she comes back to Philadelphia, but you may be assured that I will bring it to her immediate attention.

If I may be of any further assistance please do let me know.

Sincerely yours,

Mrs. Lanny Bell

Received - mailed Beth's letter of March 12  
on March 18



N a r o d n i   M u z e j  
K r a g u j e v a c  
J u g o s l a v i j a

3 April 1969

Dr. Elizabeth K. Ralph  
The University Museum  
Philadelphia, Pa. USA

Dear Dr. Ralph:

Thank you for your letter from the field dated 12 March. I would have gotten to it sooner but for being fully tied up in a report to the Smithsonian.

Divostin has neolithic material on the surface over an area of about 45 hectares, or 4500 m<sup>2</sup>. There are some buildings, however, that would make any kind of complete survey impossible. The Geomagnetic Institute did some profiles--readings every 5 meters in a straight line--which I didn't find very useful, and covered the area near our most productive excavation, also at an interval of 5 meters or, where it was necessary, 2.5 meters. All in all they covered what would be the equivalent of about one hectare. They took 15 days in doing it, and charged us \$1600.

Obviously it wouldn't be possible to cover all of the site with a magnetometer survey, but I would very much like to have about 10 more hectares done.

If possible, for the other sites that we want to test, I would like to have another set of surveys done; we want to work at about 5 sites, and I would estimate that perhaps 3 or 5 hectares ought to be magnetometerized on each of them.

I have no idea how this will fit in with your plans. I have been so rash, however, as to incorporate you in advance into the additional funds I am requesting from the Smithsonian. I have asked for your passage from Italy and back with 100 kilos excess baggage, plus round trip flight for an eventual assistant, plus 20 days of per diem at \$14/day in local currency for you and the assistant, and also have asked for a contingency fund in case you have to be brought from the States. We could use your services here any time after the 15th of April.

By the way, I suggested the random sampling of 100 x 100 meter squares, or of 5 x 5 meter squares, because of the impracticality of surveying the whole site and developing a map of anomalies for it. It seemed to me that such a technique would make it possible to state (in probabilistic terms) how features are distributed on the site. I would not insist on particular methodology, however.

Did I mention that the Geomagnetic Institute was getting readings in the range of about 60--120 gammas from the houses? They are now measuring our oriented samples from the hearths, and say they are "strongly magnetic."

Bucha turns out to be at La Jolla. Neustupny may come, however.

Sincerely,

Alan McPherron

April 15, 1969

Dr. Alann McPherron  
Narodni Muzej  
Yugoslavia

Dear Dr. McPherron:

Thank you for your letter of April 3rd. Since time is getting short for corresponding, I am writing to say that I hope to be able to spend most of the month of June at your sites.

If all goes well, I shall leave here by ship on May 10th. After that, I'll collect mail and messages from time to time at the Hotel Boston, Via Lombardia, Rome. Since I have a Fiat 850 in Rome, I am wondering if it will be possible for me to drive to Divostin. The main thing that worries me is that I may have trouble with customs and all the instruments at the border. If you think that this will be difficult, please let me know so that I can plan to fly from Rome to Belgrade.

It now seems unlikely that an assistant from the USA will join me, but I think that I can get along all right with local workmen if someone can help to interpret the language for the first few days.

Sincerely yours,

Elizabeth K. Ralph

EKR/mrb



Narodni muzej  
Kragujevac  
Jugoslavija

Italy + back  
100 kg  
\$ 14/day

22 April 1969

Mrs. Wingfield

Dr Elizabeth K. Ralph  
The University Museum  
Philadelphia, Pa. USA

Dear Dr. Ralph:

I am overcome with joy to hear that you will be able to work with us here. The prospects for the coming field season are shaping up very nicely. Dr. Neustupny (junior) will be coming in late June with an assistant to collect samples from hearths; we are expecting a Dr. Hans-Juergen Beug to come with an assistant to collect paleobotanical materials; we are still hoping that Dr. Klaus-Dieter Jaeger will be able to get here from East Berlin to look at geomorphological problems--which at Divostin are however not very striking, as it turned out.

You did not mention how your travel is going to be financed. I trust that if support for travel from the Smithsonian is required you will get in touch with them. Call the Director of the Foreign Currency Program if necessary; he is Mr Kennedy Schmertz and his number is (202) 628-1810 x 5091.

You should have no trouble driving here from Rome, and of course can get any service you need on the Fiat 850 right in town here, since we have the Fiat-licensed "Crvena Zastava" (Red Flag) factory. My daughter in fact goes to their pre-school, the only satisfactorily-functioning organization I have yet detected in Serbia. The road to Trieste you probably know; from Trieste to Ljubljana it is windy but good; from Zagreb to Beograd horribly bumpy but straight as an arrow but watch out for the trucks. From Beograd to the Kragujevac-turnoff from the "Autoput" is about 2 hours. It is poorly marked. Kragujevac is 27 km from the turnoff. Call me when you arrive--best call from a hotel--or ask for the Narodni muzej. My number in town is 26-22.

I doubt seriously if you will have any trouble at all with customs, but in any case I will get you an official letter that, if necessary, will enable you to get a sort of carnet for the equipment. You will declare that you will re-export it. Better not to bother if not needed; no one cares, and officialdom can tie you down the better part of a day. Will the instruments and all fit in the 850?

If you are going to get to Rome on or about the middle of May, do you suppose you could come here before the first of June? It would be awfully convenient if we could have a little survey on one of the sites to be tested before the testing team gets to it.

Maybe you will wish to telephone me some evening after you arrive in Rome. My brother incidentally will probably be there making a film at the time. He lives near Florence.

Bon voyage, hope you make the 10th May ship, and we're hoping to see you here.

Sincerely yours,

*Alan McPherron*

Alan McPherron

It don't  
drive -  
wire from  
Rome -  
to Kragujevac  
Embassy  
will disperse  
that money  
to him  
Yugoslav  
Embassy



April 29, 1969

Dr. Alan McPherron  
Narodni Muzej  
Kragujevac  
Yugoslavia

Dear Dr. McPherron:

Thank you for your letter of April 22nd. I think that it will be difficult for me to arrive before June 2nd or 3rd because I am supposed to work at Ciro in southern Italy in May. If, however, Ciro is not appropriate for magnetometers, I'll come around May 27th.

I think that it will be helpful to have an official letter in case I have trouble with customs. The instruments do fit in the Fiat 850, but they are heavy, that is why I'm coming to Italy by ship, which uses up a week in May.

I just talked to Mr. Kennedy Schmertz, and he said that since I am going by car, there is no way that I can be reimbursed until I arrive in Kragujevac. If I find the Fiat broken down, and have to come by air, he said that you could reimburse me and then the Embassy would refund the airfare to you. I am looking forward to the trip.

Sincerely yours,

Elizabeth K. Ralph

EKR/mrb

May 2, 1969

Dr. Alan McPherron  
Narodni Muzej  
Kragujevac  
Yugoslavia

Dear Dr. McPherron:

This is a hasty note to say that I have just found out that the Hotel Boston is closed. Therefore, if you need to write to me in Italy, my address will be:

c/o Signorina Franca Callori  
Via Aventina 59  
00153 Rome, Italy

Her telephone number is 575851, but I am not likely to be there for more than one or two nights.

Sincerely yours,

Elizabeth K. Ralph

EKR/mrb

NARODNI MUZEJ  
Broj 547/1-69.  
2.jun 1969.godine  
KRAGUJEVAC

MŽ/MP

Na osnovu člana 117.Statuta Narodnog muzeja u Kragujevcu, donosim sledeće

R E Š E N J E

1. da se ELIZABETHI RALPH, inženjeru geofizike iz Pitsburga /SAD/, koja učestvuje na geološkom istraživanju jugoslovensko američkog Projekta arheoloških istraživanja u Divostinu, preko Narodnog muzeja u Kragujevcu, isplate troškovi izdržavanja za vreme od 2.juna do 15.jula 1969.godine, u iznosu od 6.900.- /šest hiljadadevetstotina/ dinara.

2. Pošto prednja isplata nema karakter ličnog dohotka isplatiće se bez odbijanja ikakvih doprinosa.

O b r a z l o ž e n j e

Ugovorom broj 8/0592 između Saveznog zavoda za međunarodnu tehničku saradnju u Beogradu i Smitsonion institucije u Vašingtonu /SAD/ na izvodjenju zajedničkog jugoslovensko-američkog Projekta arheoloških istraživanja u Divostinu koji finansira Smitsonion institucija preko Narodnog muzeja u Kragujevcu predviđeno je učešće i inženjera geofizike za izvestan vremenski period.

Pošto su sredstva za ovu isplatu obezbedjena i stavljena na raspoloženje Narodnom muzeju u Kragujevcu, to je rešeno kao u dispozitivu.

DIREKTOR,  
Milovan Živković



June 4, 1969

c/o Dr. Alan McPherron  
Narodni Muzej  
Kragujevac  
Yugoslavia

Hotel  
Kragujevac

hotel-raphael-

HR

00186 - roma  
largo febo 2  
(piazza navona)  
Telef. 6589051  
telegr. raphotel

Dear Fro,

The rest of the trip here went well. To my dismay, I found that June 2<sup>nd</sup> was also a holiday here, so about all I did was get organized. There is a house at the site (Divostin) which is convenient for the instruments, battery charging, etc. They insist upon surveying the grids before I do them, and the surveyor is the laziest man in the outfit. Therefore, yesterday morning I went with the audio gadget to a site midway between here & Belgrade. Sergi (sp?) had found a very early Neolithic pit, but unfortunately, it was right beside a large transformer and many power lines. Outside of this area, there seemed to be nothing. In the afternoon, we finally got a grid started and finished it and another one today at Divostin. With our extra sensitivity we are picking up more magnetic disturbances from the subsoil than the people from the Belgrade Institute did with their old proton magnetometer. Therefore, I plan to experiment with the sensor higher, reduced sensitivity, etc. Even with the disturbances, the burnt house floors should be detectable - they are stronger and have different shapes.

The language barrier is a problem. If I had just one Nunzio or Giacinto with me, I could work much faster. Yesterday, I had to wait until the end of the work day (6:00 A.M. to 2:00 P.M.) for McPherron to be free to tell the workmen what I wanted them to do. Today, the lone student who speaks both languages worked with me, but most of the time she is busy. However, the workmen are learning. (We have breakfast at 9, lunch at 2, and no siesta).

I forgot to mention that Ciró might be a good spot for aerial photography. The anomalies we found were in areas of green grass as opposed to barren areas with brown grass. Since the soil is so sandy, perhaps more earth has accumulated around the structures over the years. It is probably a bit late in the season for this year.

Best regards,  
Beth

June 10, 1969

Dear Beth:

Pen and I are leaving here on the 14th for Ireland, then Oxford, London and, I would guess, Belgrade about the 20th or 21st of June. We will rent a car and drive to the site for a day and then return to the South of France, where plans are still uncertain because of the necessary permissions. At the moment, I don't know whether John will do the survey there in July or September, but he will be standing by to hear from me when I get to Montpellier. We should be back in the States by about July 7.

I just have your note of June 4 written from the site in Yugoslavia, and I note that you have gotten started. I also have your notes about Ciro but I am puzzled because I thought you were to pick up Rutter at Ischia to do the test digging. That was all arranged with Foti. In any case, we will have to devise some way to follow up on that.

All the best. Seeyou shortly.

Sincerely,

Froelich Rainey  
Director

Dr. Elizabeth K. Ralph  
c/o Dr. Alan McPherron  
→ Hotel Kragujevac  
→ Narodni Muzej  
→ Kragujevac, Yugoslavia

FR/c

July 10, 1969

Dear Alan:

Many thanks for your July 4 letter which reminded me of tramping around in the hot sun at Corsa on the 'holiday.' The ground there was again magnetic, so I showed them how to use the Geohm and with it, it looked as if we were picking up some harbor walls.

I left for U.S.A. on July 6 to be back in plenty of time for the NSF site visit -- all for nothing. The NSF is giving us our grant without a visit. It is very frustrating because I could have returned to your grain fields.

About the dinars, I changed them at a 20% loss on the Italian side of the border. At any rate, I had plenty to pay for the Fiat and me in Venice.

I was glad to hear that the anomaly above the field house was a good one, and I am not surprised that the one at Dobrovidica yielded nothing.

I miss Yugoslavia and your good company very much. Fro and I look forward to your visit here.

Best regards to all,

Elizabeth K. Ralph

Dr. Alan McPherron  
Narodni Muzej  
Kragujevac, Yugoslavia

EKR/c



N a r o d n i   m u z e j  
K r a g u j e v a c  
J u g o s l a v i j a

*Ralph  
HSCA*

4 July 1969

Dear Beth,

Delighted to get your letter of 29 June from somewhere in Italy. Glad you had a relatively uneventful trip, but the blowout [!] and the "Other Repairs" in Venice sounded awful, especially since you started out with such a load and with a bum muffler to boot.

[What did you do with the dinars? ]

We tested the anomaly above the field lab and it turned out to be a beautiful little house. We tested the "[Anomaly]" at Dobrovidica but so far (two days work) it has yielded poor results, so apparently it must be of geological importance only..

Everyone here misses you and I must say I wish you were back to work in the wheat fields, now mostly harvested, and to talk to. Your visit was a really great thing, and will probably change the texture of Jug. archeology permanently. Incidentally Srejović and everyone else also greatly liked Dr. Rainey--there have been other Americans with ~~some~~ <sup>whome</sup> that was not so.

Incidentally I collected about 40 kilos of samples with Neustupný which we have already sent off to him. We have about covered the Jug. neolithic, and it will be great to see the results. The Geomagnetic institute didn't do much for Mrs Kalenská, but we took her with us and my project put her up for a week in Belgrade.

We will impinge upon you geomagnetically and anatomically, meaning that we will come up to see you, some time this coming autumn/winter, at your convenience, in Philadelphia. I have in my travel with Neustupný found about 20 other sites that I would like to test and take geomagnetic samples from. We will really need that fluxgate instrument next year.

We greatly enjoyed having you; we greatly miss you; we wish you could return here. Hope your return trip to USA was pleasant. Thanks for the Jug; stamps. With warm best wishes and thanks for your participation here,

Sincerely

*Alan*



N a r o d n i   m u z e j

K r a g u j e v a c

J u g o s l a v i j a

7 July 1969

Dear Beth,

The enclosed letter arrived a few days ago; and because we had discussed the subject and I thought the contents might be urgent I had the temerity to open it. I hope you will not be annoyed at my having done this. If possible I would like to have him come next spring or summer, at which time it would be very nice if he could do several sites if that would not mean that, for each site, a separate filling of 18,000 liters of hydrogen were necessary. It does seem like an enormous amount of gas; I wonder what the stuff costs? And surely it is also dangerous to life [Hindenburg Zeppelin]?

Other than these considerations, I have no comment and am eager to see what his balloon will do.

We have been digging the anomaly at Dobrovdica, and are finding nothing but little bits of pottery; no house-rubble or other interesting features. We are not yet at sterile subsoil, however, so something may come of it. But considering we know the site extends for some distance and this was the only anomaly, the logical conclusion seems to be that it is of geologic nature. Will let you know further as things develop.

I missed seeing ourselves on television. Those who saw it said the video was OK but that the text was terrible. About par.

We expect to test Rajac in a few days, and I will report also on that.

Everyone asks after you and sends regards. Hope everything is going well with you and the Museum. My best wishes to the Rainey's.

With all the best,

A handwritten signature in blue ink, appearing to read "Alan".

Alan McPherron



N a r o d n i   M u z e j  
K R A G U J E V A C  
J u g o s l a v i j a  
10. II. 69

Dr Elizabeth K. Ralph  
The University Museum  
University of Pennsylvania  
Philadelphia, USA

Dear Dr. Ralph:

Thanks for your letter of 14. I. 69. I have been out to the Geomagnetski Institut, showed some of the reprints you so kindly sent me to the people there, and am now able to answer some of your enquiries about the work they did at Divostin.

You ask about the area of search. They did several linear profiles, totalling about a kilometer, and also covered an area about 100 x 100 meters with stations at 5-meter intervals. Next season it would be desirable to do grids on the other sites we will search and test-excavate, as well as do a little more at Divostin.

Now it is clear that the cost would be prohibitive to completely grid each of say ten sites with an interval of even 5 meters. What would you think of the idea of doing ordinary probability sampling, perhaps a simple design of taking a 10% random sampling of 50 x 5 meter squares and taking say 9 readings in each of these squares. If the objective is to learn something about the distribution of anomalies on the site, it seems to me clearly preferable to arbitrarily-chosen long profiles across the site, or in fact any other biased sampling method. Perhaps there are valid reasons against such a random sampling design, however.

The depth of the features at Divostin vary from -20 to -150 cm below surface. They are thus both wide and shallow, and your new fluxgate magnetometer sounds exciting. I cannot promise that anomalies will be so shallow at the other sites, on the other hand.

As to the magnitude of the anomalies: they were getting readings in the order of 80 to 120 gammas. This is a strong contrast with Lepenski Vir, where they were getting seldom more than 10 gammas, and is another reason why I am excited about the prospects here.

They asked me at the Geomagnetski Institut, whether you took readings at only one elevation above the ground or not. They took readings for us at (about) 20, 60, and 120 cm, and pointed out that unless this is done, information on the significance of the observation cannot be obtained.

Today I got a letter from Dr Evžen Neustupný in Prague, who writes that Bucha is now with Suess in San Diego, but that he (Neustupný) would be happy to come to Serbia to collect samples, especially if they can be <sup>C14</sup> cross-dated. That of course can be done. Can you tell me a good place to send samples of house rubble ("daub") and animal bone (collagen) for dating? Perhaps your laboratory would be interested.

Again thanks for the separates, and hope that we can get together here in late May or early June (or late June).

Sincerely yours,

Alan McPherron

UNIVERSITY OF PITTSBURGH  
PITTSBURGH, PENNSYLVANIA 15213

DEPARTMENT OF ANTHROPOLOGY

19. XI. 69

Dear Beth:

Here is the draft of a short paper on the work, with special emphasis on the magnetometer work. You can cut it up, add your own material, and alter it in any way you see fit.

I had a rather hard time with it since I had no idea of the precise audience to which it is to be addressed. For that reason it may appear rather oversimplified in places (~~in~~ e.g., spelling out the advantages of shallow sites). For an article for **SCIENCE** I would probably make some alterations. On the other hand, in the last section, on research design, I may have presented complex ideas in too compressed a form. You will know better what kinds of material can best be presented.

I will be ready to come to consult with you on this any time after Monday.

By the way my call to you on Friday will be from the AAA meetings, in New Orleans.

Hope you had a good tour. Bet you're tired.

Best wishes,



Alan McPherron

need map



DIVISION OF THE SOCIAL SCIENCES  
UNIVERSITY OF PITTSBURGH  
PITTSBURGH, PENNSYLVANIA 15213

DEPARTMENT OF ANTHROPOLOGY

28 Nov 69

Dear Beth:

Here are 2 copies of my suggested revision of the paper. I have completely rewritten the first 2 1/2 pages, and changed the last paragraph of the paper. Let me know if you want further changes. I completely agree with you that more was needed about Divostin.

I hope you got the copy of the map that I sent to "Woosamonsa". If not, please telephone me. Office: (412) 621-3500, ext. 277 OR 7337 OR 7338. Home: (412) 421-2614. You can call me at home any time till midnight with no hesitation.

Regards

*Alan*



DIVISION OF THE SOCIAL SCIENCES  
UNIVERSITY OF PITTSBURGH  
PITTSBURGH, PENNSYLVANIA 15213

DEPARTMENT OF ANTHROPOLOGY

8 Dec 69

Dear Beth,

Here is a map, the selected readings, a suggested biographical sketch, and a curriculum vitae in case you need other data on me. You may alter the biographical sketch as you see fit, providing of course you don't thereby malign my character or whatever!

Hope everything will turn out all right.  
Best wishes for a pleasant holiday season.

Yours

Alan McPherron

Apparently I have no B/W  
of you; can you have  
him make a neg. of one  
of the slides I sent, to  
show you in action?

UNIVERSITY OF PITTSBURGH  
PITTSBURGH, PENNSYLVANIA 15213

DEPARTMENT OF ANTHROPOLOGY

19 Mar 70

Dear Beth,

Let me first tell you how much I enjoyed visiting you at Woosamonsa the other day. I never accurately got the name of the other guest--would you please let me know some time?

I am enclosing: (A) a report I hope to get into NATURE on the Geomagnetic Institute's participation in the project, to balance off our things in EXPEDITION and (I hope) SCIENCE. They sent me a Serbocroat paper and a translation of it, which I am sending to you as "B". As you see, I have mainly adapted their "English" version, turning it into English and adding some archeological stuff. Would you be so kind and look it over to see if there are any questionable points from the geomagnetic angle? In my opinion, they are awfully vague at a number of places, and then I'm not sure that some of the terminology is correct.

Finally, I can't find your Mobile drilling rig or coring company anywhere in our Pgh phone book. Would you please send me their address?

I mailed back the book you lent me, so if there's no further mail strike it should be there in a few days.

Best regards, thanks for your hospitality, and hope to see you again soon.

Yours,

*Alan*



# Telegram

703P EDT MAY 30 70 PB460  
SPB298 MB171 VIA RCA M WUB1622 RMB9131 YJU885

KRAGUJEVAC 19 30 1900  
LT UNIVERSITY MUSEUM 33 AND SPRUCE

RALPH ANTIQUE

PHILADELPHIA USA

NOGRADIENT ORREACTION TOORIENTATION TILLINCHES  
FROMIRON THEN SUDDENLY FULLSCALE USINGHOUR WARMUP  
LETTER FOLLOWS POTTWISTING NOHELP "

*6/2/70 Try adding  
fifth battery in series*

Telegram



703P EDT MAY 30 TO PB460

SPB298 MB171 VIA RCA M WBLESS RMB9131 Y1888

KRAGULJEVAC 19 30 1900

LT UNIVERSITY MUSEUM 33 AND SPRUCE

RALPH ANTIQUE

PHILADELPHIA USA

NOGRADIENT ORREACTION TOORIENTATION TILLINCHES

FROMIRON THEN SUDDENLY FULLSCALE USINGHOUR WARMUP

LETTER FOLLOWS POTTWISTING NOWH BOUND TO

MISSION NO

EVA 7400

C-322053

Narodni muzej  
Kragujevac  
Jugoslavija  
30 May 1970

Dear Beth,

I had a rather bad trip here. I first missed my plane in New York because it took so long arranging for air cargo for a lot of the stuff, including the gradiometer, and then because there were delays in getting the car arranged for. I actually had to drive it to Pier 1, Erie Basin, Brooklyn, and deliver it into the dubious hands of the longshoremen. I wonder if I'll ever see it again. And that all was after a night of very little sleep. So of course I caught cold in London, so spent a week with my brother at their place near Florence, where I fully recuperated. I rented a Topolino in Trieste and drove across Yugoslavia, and finally got the stuff out of hock at Air Cargo in Belgrade with surprisingly little trouble, and made my way here, arriving the day before yesterday.

Just today I got around to putting the gradiometer together, and I am sorry to have to report that there is some trouble. I can't get it to work properly. When I first put it ~~together~~ together and turned it on, I could hear the 30 Hz. tone as described, but nothing else. The meter, when connected, read zero. ~~When I held it near an iron stove, and still got nothing.~~ I held it near an iron stove, and still got nothing. So I thought maybe it was getting swamped by all the metal in the building, and took it way out in the field, in fact to one of the fields at Divostin that yielded no anomalies. I still got absolutely nothing. Later in the day, I tried it again, and this time found I could get it to react to large pieces of iron when the probe was held a few inches away. What it did was to register zero until I had the probe very near the iron, when it would suddenly swing to a high pitch and go full-scale neg. or pos. on the meter. But it would not pick up anything else, nor could I get it to react to changes in orientation, even after doing quite a bit of diddling with the four pots, X, Y, Bal, and Zero. I checked voltage and found it to be about 16.5 under load, which seemed fine. I checked for loose connections insofar as I could spot them, and disconnected and reconnected the Amphenol connector you installed several times in case contact was not being made there; no result. One thing did seem odd: Mita who was there at the time found the ~~black~~ black end-cap at the end of the probe could be twisted rather easily. But when I tried it I found that was not the case. I doubt that's relevant, but just thought I'd mention it.

I have no idea whether you or the Schonstedt people will be able to diagnose the problem from afar, especially since it's a prototype model, but anyway I sure hope something can be done. I sent you a telegram just now in an effort to possibly shorten the time necessary to start dopping out the problem.

I forgot to mention that, after first finding it would squeak near iron, I left it to warm-up (cool-down?) for an hour--still no help. I can find no signs of damage due to shipment, although of course both halves pressed into the aluminum corners of the case at their ends.

I'm afraid to attempt anything further at this point, for fear of causing damage, so I'm going to put it aside and get other things done until I hear from you. Too bad, and I'm sorry to bother you about this.

By the way, I could use 6-8 more copies of Expedition here if you can spare them. And could you please have the

photographs I sent you for the publication sent back to Pittsburgh? I am particularly eager to get the joined halves of House 99 back again.

Otherwise all is about the same here, if you know what I mean. I'm going to Belgrade tomorrow to consult with Srejavic, and to see a number of other specialists. My students won't be here for a couple of weeks, so I can still get a lot of that sort of thing done.

Best wishes, and again I regret to bother you with the problem,

sincerely yours,



Just today I got around to putting the gradiometer together, and I am sorry to have to report that there is some trouble. I can't get it to work properly. When I first put it together and turned it on, I could hear the 30 Hz. tone as described, but nothing else. The meter, when connected, read zero. I held it near an iron stove, and still got nothing. So I thought maybe it was getting swamped by all the metal in the building, and took it way out in the field, in fact to one of the fields at Divostin that yielded no anomalies. I still got absolutely nothing. Later in the day, I tried it again, and this time found I could get it to react to large pieces of iron when the probe was held a few inches away. What it did was to register zero until I had the probe very near the iron, when it would suddenly swing to a high pitch and go full-scale neg. or pos. on the meter. But it would not pick up anything else, nor could I get it to react to changes in orientation, even after doing quite a bit of fiddling with the four pots, X, Y, Bal, and Zero. I checked voltage and found it to be about 18.5 under load, which seemed fine. I checked for loose connections insofar as I could spot them, and disconnected and reconnected the Amphenol connector you installed several times in case contact was not being made there; no result. One thing did seem odd: Mike who was there at the time found the black end-cap at the end of the probe could be twisted rather easily. But when I tried it I found that was not the case. I doubt that's relevant, but just thought I'd mention it.

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By the way, I could use 8-8 more copies of Expedition here if you can spare them. And could you please have the

June 5, 1970

Dr. Alan McPherron  
Narodni Muzej  
Kragujevac  
Yugoslavia

Dear Alan:

I was sorry to hear that you had such a bad trip, and especially that the magnetometer is not working.

It is possible that I put it out of kilter by adding that plug. The Schonstedt people have suggested that there may be a bad connection that is making high resistance and a consequent reduction in sensitivity. If you want to look at the wires, loosen the brass fittings first and then the Amphenol collars, being careful not to twist the wires in the process. (Don't worry if you do break them since it may not work anyhow).

First thing to try, though, is adding a fifth battery in series to jack up the voltage. This might also help to overcome the high resistance if present.

If it still doesn't work, you can ignore it until you come back or send it back if you can get it out of Yugoslavia without too much difficulty. Dr. Rainey will be in Italy for the month of June, but at the moment his address is unknown and also he doesn't like to carry things. Therefore, it would be best to send it directly here if that can be arranged.

The Lockheed people hope to have one of their magnetometers ready for our use about July 1. Since this weighs only 1 lb, I could fly over with it for a brief visit if that suits you. To bring the cesium also, I should need the help of a student and we do not have funds for two air fares. Therefore, if the Lockheed unit is ready, I'll plan to come alone

Dr. Alan McPherron  
Page 2  
June 5, 1970

with only the fluxgate if that is O. K. with you. If there is no real need for it, please let me know.

We shall send you ten more copies of Expedition.

I hope the other phases of your trip and work go better.

With best regards,

Beth Ralph

EKR/c

Ralph

Rainey's Expected to  
Arrival Yugoslavia  
20 June

Crownover

Crownover



# Telegram

1129A EDT JUN 17 69 PC312 MD121  
M CDC493 VIA RCA ZCZC WUD6513 RML5121 YJU116  
URNX HL YUBE 020  
BEOGRAD 20 17 0908 GS

LT  
(UNIVERSITY MUSEUM 53RD AND SPRUCE STS  
RAINEY ANTIQUE PHILADELPHIA SAD.

LT PLAN TO LEAVE KRAGUJEVAC ABOUT JUNE 23 PLEASE ADVISE  
SOONEST RE YOUR VISIT BETH  
COL LT LT 23

~~ASCA~~  
Yugo.  
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TELEPHONED TO 9:22 AM \_\_\_\_\_

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1122A EDR 200 IV 02 P0212 AD121

1969 JUN 17 PM 12 00  
DY

RECEIVED

N a r o d n i   m u z e j  
K r a g u j e v a c  
J u g o s l a v i j a

replied 6/23/70

17 Jun 70

Dear Beth,

Thanks for the cable. I tried adding the 5th battery, but there was no effect whatever. I have not tried opening up the connection, since it seems unlikely to me that, unless you used a tinner's copper with acid-core solder, yanking each wire after you soldered it to test its firmness, the connections should be faulty, although of course this possibility must be tested. Instead, I have let Dr. Stefanovic of the mining-and-geological faculty have a look at it. He has an electronics lab there with a fair complement of equipment, and feels that he can trouble-shoot it. He used to be with the Grocka people--was until this spring in fact--but let his joint appointment there drop when the term expired, apparently because of unhappiness with the Grocka outfit. At least he darkly hinted about that, and his colleague ~~man~~ on the faculty Dr. Muzijevic has also dropped his joint appointment.

In order for us to have a proper look at things, I wonder if you could send me two pieces of information:

(1) circuit diagrams for the "black-box" integrated-circuit items in the magnetometer--there are a fair number of them and they are not spelled out in the circuit diagram supplied with the instruction manual; and

(2) information as to what is in the probe head and what is located in the electronics-and-batteries part of the magnetometer. This also is not shown in their circuit diagram.

I am most eager to get the thing into operation, because I am constantly seeing situations where I could use it. If we can't I'd like so much to have you come. Or, let's say just come over anyway if you can, with the Lockheed if it's ready by then, if it has an calibrated readout. I'll let you know the situation with regard to the Schonstedt as soon as I can, and then you can make up your mind. We would love to see you.

Having given you a depressing picture of things here I want to tell you that I have 3 students in the lab--I don't think you ever saw where we are located, across the river from the (ugh) museum, where we work in peace and quiet, lunching out in an enclosed patio every day, swimming in the reservoir every afternoon. The work is going excellently; I am very happy; relations with the people here are much better. Incidentally we will be digging briefly, mostly to test anomalies and other sites, from about 10 July to maybe the end of the month.

I never asked to have you pack up and send back to Pittsburgh the original photos from the article. Could you please either hold them till my return, or else send them back to my office? I especially don't want to lose the big photo of House 99.

So best regards and it really would be nice to see you here (the Hotel still remembers you and asks after you).

Sincerely

*Alan*  
A McPherron

June 23, 1970

Dr. Alan McPherron  
Narodni muzej  
Kragujevac, Yugoslavia

Dear Alan:

Your letter of June 17th arrived today and I have talked again to the Schonstedt engineers. They do not have any circuit diagrams other than the one supplied with the magnetometer and what is in the sensor is their secret. Also, the sensor is potted and cannot be opened without sawing it apart and destroying it. I do know that the sensor has two fluxgate elements located about 8 inches apart. There are also two balancing coils which may be located in the sensor, but I am not sure of this. At any rate, the controls for the balancing adjustments (screw driver slots) are in the electronics box.

The engineers suggested that the loss in sensitivity could be due to high resistance in one of more of the cable connector contacts or connections, or to failure of one or more of the 3N128 RCA transistors. (There are supposed to be 6 of them),

Therefore, there are two things that your electronics man could do -- namely:

1) Change all of the 3N 128 transistors. I'll send you these in one or more letter-type envelopes with the hope that they will not get caught in customs.

2) Remove the cable connectors and resolder the wires back together. They are all numbered so that this would not be too difficult. Then, maybe you could rig a spoint or something to hold the two ends of the shaft together.

Which of these two you do first doesn't much matter except for the inconvenience of fastening the shaft back together for #2.

If you succeed in getting it working, could you please cable me so that I won't set forth with the Lockheed instrument if it happens to be ready.

Best of luck,

Beth K. Ralph

Narodni muzej  
Kragujevac  
Yugoslavia

15 July 1970

Dear Beth:

Thanks for your letters, and in answer to yours of the 23rd June I can say that I got the transistors but that in fact I have essentially given up on the whole affair. The people in Belgrade did nothing at all to fix it as far as I could see, although they said they were able to find some cold-soldered joints. Later, I found that with the cover off, if you bent the whole circuit board arrangement, it jumped in noise frequency, indicating something else loose. I managed to locate another bad joint, then found a broken wire (one of the leads out of the pipe leading to the probe and connecting with the fibreglass terminal board) and fixed that, then found it had a fair sensitivity for the first time, but still was unable to zero it by adjusting the pots and rotating it etc. as per instructions--the pots now make some difference but you still can't eliminate the effect of moving the instrument about in a dead ambient field. In addition, there is a constant problem with breaking leads, batteries falling out of place with the cover off, etc. I then found two wires that just stick there without being joined to anything, by the way. I can't tell if they are meant to be that way, though one is intentionally clipped off and the other, which has about 8 mm of ~~uninsulated~~ stripped insulation, has the protruding wire tinned but there is no evidence that it either broke off or came accidentally unsoldered.

So I have given up and think it best if we just drop the whole matter of geomagnetic investigations for this season, since in addition to this I have a big slew of other problems, such as you would expect with a crew of 17 Amer. and British students working on the artifacts for publication, two other Distinguished Archeologists, and Specialists arriving every other day. It is just too much.

Amazing that the transistors came through. Pity that seems not to have been the problem. One of the problems is in mechanical design. Not to MIL specs, definitely. Also, they should have anodized the damn thing PINK rather than OLIVE DRAB because I have

constantly to keep the thing under cover because everyone things I'm looking for hidden cables and mines and munitions and the like. Maybe with purple polka-dots. Or disguised as a transistor radio.

I wonder if the Belgrade people are responsible for the wires that are just dangling there...

Otherwise, things here are going excellently though exceedingly hectically. We haven't even begun to dig (much less fight) so it could even get worse the main problem being that I need to be three people at once instead of just one miserable Poo-Bah.

But I am really enjoying it and quite in contradiction to last year have absolutely no personnel or interpersonal problems. All is sweetness and light, only I just need 64 hours to the day.

Would you believe it, I am getting rheumatism or "tennis elbow" or something so the hardest thing for me physically right now is punching the typewriter?!

Regards to Fro, and all the others, and when I get back we'll redesign the damn thing and I'll have some words with Schonstedt.

Zdravo, Ciao, and Mahzel tov

*Alan*  
A. Mcpherron

Principle American Investigator  
And a Half.

Note Freudian slip  
(typed h in place of n)

## CESIUM MAGNETOMETER STUDY OF BALKAN NEOLITHIC SETTLEMENT PATTERNS

In June, 1969, a number of prehistoric sites in Yugoslavia were surveyed with the cesium magnetometer. Our aim was to see if the pattern of structures in prehistoric villages could be determined before digging. The results were spectacularly good, and provide hitherto unsuspected insight into the nature of neolithic settlements, demonstrating that magnetometers can be a powerful tool in furthering the aims of modern archeological research, even at sites as early as 4000 B. C.

In part because of the elegant ceramics and human figurines, neolithic cultures in Yugoslavia have been a popular subject of study among archeologists for many years. However, with the exception of the systematic excavations carried out years ago at the tell of Vinča on the Danube near Belgrade (Vasić 1933, 1934, 1936), no site has been dug extensively enough to yield data on the nature of the settlement; that is, on the spacial distribution of houses and other structures, storage facilities, and areas of specialized activities. Such data can be obtained only through large-scale excavation, and ~~that is~~ easiest to do on shallow sites. On deep sites, the many levels of occupation cause much time to be spent in digging the upper levels of occupation so as to minimize mixing of layers.

*Can provide an illustration*

Neolithic sites suitable for such settlement-pattern study are found in large number in central Serbia, that area of Yugoslavia to the south of Belgrade, and accordingly a project to investigate the neolithic in that area was organized by Alan

McPherron of the University of Pittsburgh and Dragoslav Srejović of the University of Belgrade. Financial support was obtained from the Foreign Currency Program of the Smithsonian Institution and the National Science Foundation. Work began in September 1968 at the site of Divostin, and revealed an early-neolithic occupation of the Starčevo culture, dating about 5000 B. C., and a late-neolithic Vinča occupation, about 4000 B. C.

While the Starčevo level was preserved largely in the form of rubbish pits dug into the subsoil, the Vinča level was remarkably well preserved, with several nearly-intact house floors consisting of rectangles up to 6 by 18 meters of brick-red fired earth mixed with straw and packed to form floors. When the houses burned--it is unsure whether by accident or design--the floors achieved a nearly ceramic-like consistency and were thus preserved, along with all other imperishable contents that were lying on the floor: baked clay hearths, packed-earth bins and work areas, pottery vessels, loom weights, milling stones, flint tools and flaking debris. The pottery yield from one of them was over 80 reconstructable vessels: Such preservation was the more impressive considering that house floors were encountered sometimes as little as a foot below the surface; the situation can be explained by the fact that deep plowing had never been done on the site.

The house floors are of importance for several reasons. First, the floors and the things left on them were relatively intact, providing a remarkable record of the activities being performed at the time of burning. Second, when houses are

can provide illustration

can provide illustration

compared in terms of their pottery and other elements, using appropriate multivariate statistical techniques, inferences can be made about the social units living at the site. Similar work has been done with success for prehistoric southwestern pueblos (Freeman and Brown 1964; Longacre 1966). Third, because the magnetic properties of the fired floors and baked clay hearths reflect parameters of the earth's magnetic field at the time of burning, the houses can be made the basis of a chronological system.

The Yugoslavian Geomagnetic Institute, at our request, brought a proton magnetometer to Divostin in October 1968, and we learned that the house floors and hearths were easy to detect with such instruments. The crew from the Institute surveyed a portion of the site, locating a number of anomalies--areas with pronounced magnetic properties. In every case, when such anomalies were excavated, a house floor was found. Thus it appeared that magnetometer surveying could enable a site to be mapped--at least as far as burned houses were concerned--before digging.

In the next season, Miss Ralph brought a much rapider cesium magnetometer to the field, and gridded anomalies at Divostin--insofar as ripening wheat fields and contemporary buildings permitted--as well as at other sites in the vicinity. The results were negative at two pure Starčevo sites, because of the absence of burned earth anomalies. At two other Vinča sites, however, the results were, in one case (Rajac) good, and in the other (Grivac) downright spectacular.

*can provide illustration*

*can provide illustration -- you grid*

Grivac, another site, like Divostin, with both Starčevo and Vinča components, is about 14 miles west of Divostin, and in June 1969 two test squares were being excavated there under the auspices of the Divostin project, by Dr. Branko Gavella of the University of Belgrade, who had dug there some years before (Gavella 1959). His investigations were producing corners of two burned Vinča houses, one in each square, and each with an even more massive layer of fired-earth floor than at Divostin. *can provide illustration*

Miss Ralph surveyed an area about 100 by 140 meters at Grivac, or perhaps a sixth of the whole site. The (accompanying figure) shows the results: a patterned and orderly disposition of anomalies that can be reasonably interpreted as houses on the basis of the Divostin work and the two excavated Grivac house floors. Such ordered rows of houses are even more impressive if one can extrapolate from the surveyed area to the entire site.

The situation at Divostin and Grivac is certainly uncommon, in that one would not expect every neolithic site to have burned house floors in good state of preservation, and it is clearly important that further magnetometer work coupled with excavation be done in the area. A number of questions arise immediately from inspection of the Grivac mapping of anomalies:

- (1) Does the system of parallel rows extend to the rest of the site?
- (2) Does each anomaly actually represent a house?
- (3) Are all houses identical in terms of size and function?
- (4) Why are all the houses apparently burned here (there hardly seems room to fit in any hypothetical unburned

ones on the map), whereas at Divostin this was not the case (some houses excavated at Divostin could be detected only when subsoil was reached, when the foundation trenches for their wall were revealed as different soil colors).

A practical plan for answering at least the first three questions is as follows:

- (1) Complete the magnetometer survey of Grivac.
- (2) Study anomalies to see if consistent variations can be detected (e.g., weaker and stronger, larger and smaller, or differently shaped anomalies).
- (3) Apply and execute a stratified random sampling design (see e.g. Vescelius 1960), based on the following contingencies:
  - (a) Suggestion (2) is negative: stratify the site simply into "anomalies" and "non-anomalies"
  - (b) Suggestion (2) is confirmed: stratify according to class of anomaly, excavating a random sample of each class as well as a similar sample of non-anomalies.

It is suggested that such a research design will maximize the potentials provided by the powerful archeological tool of magnetometer survey, while minimizing the biasing effect caused by the fact that magnetometers can detect only certain classes of archeological features.

revised

CESIUM MAGNETOMETER STUDY OF BALKAN NEOLITHIC SETTLEMENT PATTERNS  
OR  
MAGNETOMETER LOCATION OF NEOLITHIC HOUSES IN YUGOSLAVIA

The first cesium magnetometer survey of prehistoric sites in Yugoslavia was carried out by Elizabeth K. Ralph in June, 1969, on neolithic sites being excavated under the joint direction of Drs. Alan Mcpherron, University of Pittsburgh, and Dragoslav Srejović, University of Belgrade. The aim was to see if the pattern of houses in a prehistoric village could be determined before digging. The results were spectacularly successful: whole rows of magnetic anomalies were discovered, and testing by excavation confirmed that they were <sup>in fact house floors</sup> ~~houses~~. The work shows that magnetometers are a powerful tool in furthering the aims of modern archeological research, even at sites as early as 4000 B.C.

Neolithic cultures in Yugoslavia are well known among specialists because of their elegant ceramics and sophisticated human figurines. In Serbia, where the study was being conducted, the earliest known neolithic farming culture is called Starčevo, and its painted pottery shows continuity with Greece and Bulgaria, areas through which the farming way of life, based on such domesticants as wheat, barley, sheep, cattle, and pigs, was diffusing from its center of origin in the Near East. Radiocarbon dates indicate that Starčevo began around 5500 B.C. in the Serbian part of Yugoslavia. Around 4500 B.C., Starčevo gave way to a late-neolithic culture called Vinča. An apparently indigenous development, Vinča is one of a number of contemporary local cultures with distinctive styles of pottery and figurines, all of them seeming to indicate somewhat improved adaptations to the local environmental conditions of south and central Europe.

Despite the fact that we know quite a bit about the pottery and other artifacts made by the Starčevo and Vinča peoples, we know very little about how they lived. Except for the systematic excavations carried out years ago at the type-site of Vinča, a tell on the Danube near Belgrade (Vasić 1933, 1934, 1936), no site has been dug extensively enough to yield data on the nature of settlement--that is, on the spacial distribution of houses and other structures, storage facilities, and areas where specialized activities were carried out. We also know next to nothing about the reasons particular spots were selected for settlement. Such information can be obtained only through expensive large-scale excavation carried out with a high level of quality control, excavation whose ultimate and optimum form is the complete uncovering of an entire settlement.

Neolithic village sites suitable for settlement-pattern studies are densely distributed in the part of Yugoslavia south of Belgrade. Sites here are shallow, minimizing problems of keeping separate the superimposed levels that plague the digging of deeply-stratified tells. One site in this area, Divostin, was selected for extensive and intensive investigations in a project organized by Drs. Mcpherron and Srejović. Generous financial support was obtained--in local currency (Yugoslav dinars) from the Smithsonian Institution's Foreign Currency Program, and in U. S. dollars from the National Science Foundation (grant nos. 8-0592 and GS-2218 respectively). Digging at Divostin began in September, 1968, and continued for six months, with a break during the winter.

Divostin at the present is a small Serbian peasant-farming village, whose local people raise corn, wheat, tree fruits and other crops, and keep cattle, sheep, and pigs. They also distill,

and consume impressive quantities of, the famous national drink schlivovits, a plum brandy. The existence of a neolithic site underlying most of the contemporary houses and fields had been known for years; Divostin was known to be a very large site, ~~to~~ with ~~have both~~ Starčevo and Vinča occupations that <sup>were</sup> ~~are~~ a little different stylistically from ones previously known, and ~~to have~~ <sup>with</sup> remains of large houses.

The excavation soon revealed that while the Starčevo occupation was <sup>poorly</sup> preserved, <sup>for the most part only</sup> ~~largely~~ in the form of rubbish pits dug into the subsoil, the Vinča level was remarkably well preserved, with nearly-intact house floors that appeared in the form of rectangles, up to 6 by 18 meters in plan, made of pounded earth and straw <sup>that had</sup> burned into a brick-red material like crumbly pottery. When the houses were burned--whether by accident or design is uncertain--the floors were rendered imperishable and were thus preserved along with what lay on them at the time of burning: baked clay hearths, packed-earth bins and work areas, pottery vessels, loom weights, milling stones, flint tools and flaking debris. The pottery yield from one house was over 80 reconstructable vessels, which is even more impressive considering that floors were encountered sometimes as little as a foot under the surface. Fortunately, the site had been plowed only superficially with ox-drawn plows. Had a modern tractor-drawn plow been used once, the site would have been destroyed.

House floors so well preserved are ~~an~~ important for a number of reasons. First, they make it easy to study the patterns of settlement on the site. Second, the distribution of materials in houses provides a remarkable record of activities that were being performed at the time of burning. When comparisons from house to house are made, using modern multivariate statistical techniques

performed on computers, inferences can be made about such non-material aspects of life on the site as the social units that existed, family life, and the organization of work. Similar studies have been successfully carried out for rooms in prehistoric southwestern pueblos (Longacre 1966). Third, archeomagnetic dating can be applied to the fired floors and baked clay hearths, because their magnetic properties reflect parameters of the earth's magnetic field at the time of burning.

CARRY ON FROM HERE WITH THE 1st PARAGRAPH BEGINNING ON PAGE THREE, WHICH STARTS "The Yugoslavian Geomagnetic...".

CHANGE THE LAST PARAGRAPH, STARTING "It is suggested..." TO READ AS FOLLOWS:

Given the fact that it will almost never be financially possible to excavate an entire settlement of the size of Divostin or Grivac, it is suggested that such a research design as the one just outlined will maximize the potentials provided by the powerful archeological tool of magnetometer survey, while minimizing the biasing effect caused by the fact that magnetometers can detect only certain classes of archeological features.

CESIUM MAGNETOMETER SURVEYS AT  
NEOLITHIC SITES IN YUGOSLAVIA

JUNE 1-24, 1969

by

ELIZABETH K. RALPH

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INTRODUCTION

Excavations at Divostin, about 8 km W of Kragujevac, in the fall of 1968 by Dr. Alan McPherron (Dept. of Anthropology, Univ. of Pittsburgh) in collaboration with Dr. Dragan Srejović (Univ. of Belgrade) revealed some Vinča house floors burned in situ, at depths of less than one meter. Dr. McPherron realized that these floors, consisting of fired clay, might be readily detectable with magnetometers. This supposition was confirmed by a preliminary proton magnetometer survey made by Drs. Ranko Mužijević and Draguljub Stefanovic of the Geomagnetic Institute, Grocka, <sup>and</sup> Belgrade (directed by Ing. Radomir Turajlić) in October 1968. In a grid, roughly 110 by 40 meters, at least, 5 anomalies characteristic of burned house floors were detected. (Three of these have now (June 1969) been confirmed by excavation. Also, outside of the grid area other anomalies were

detected in a few profile plots of lines. Full details of this proton magnetometer survey as well as subsequent measurements of magnetic susceptibilities are contained in the excellent report by Dr. Mužijević and Stefanović.

The magnetic measurements reported are as follows:

<u>Sample</u>	<u>Magnetic Susceptibility</u>	<u>Remanent Magnetization</u>
Burnt house floor	$4 \times 10^{-4}$ emu	$7.2 \times 10^{-4}$ emu
Fired clay from a hearth	$14 \times 10^{-4}$ emu	$18 \times 10^{-4}$ emu

As a result of this successful survey, it was obvious that it would be worthwhile to conduct more extensive magnetometer surveys at Divostin and at other Neolithic sites with similar burned house floors. Therefore, Dr. McPherron invited the writer to come this year with the MASCA (Applied Science Center for Archaeology, directed by Dr. Froelich Rainey) cesium magnetometers. The big advantage of these magnetometers is that with them areas can be covered much more rapidly. Also, they are more sensitive, but greater sensitivity is not needed at these sites.

#### MASCA CESIUM MAGNETOMETERS

1. Varian Associates Precision Portable Cesium Magnetometer Model 4920

This instrument was designed specifically for archaeological prospecting by Varian Associates (Palo Alto, California, U. S. A.) at the request of the University Museum, Univ. of Penn-

sylvania. The components are the readout, cesium sensor (or sensors) and battery pack. It is lightweight and readily portable. Its maximum sensitivity with one sensor is 0.1 gamma. The principles of operation as well as its application in the search for Sybaris in southern Italy are described by E. K. Ralph, Frank Morrison, and D. P. O'Brien in "Archaeological Surveying Utilizing a High-Sensitivity Difference Magnetometer", Geoexploration, vol. 6 (1968) pp. 109-122.

The Model 4920 contains also a difference circuit for use with two sensors. The second sensor may be used either in a gradiometer arrangement or it may be placed in a fixed station in the center of a grid. The second sensor serves to cancel out diurnal and other extraneous magnetic variations, and only the difference between the fixed and movable sensors is read. When operated as a difference magnetometer, the second sensor replaces the crystal oscillator to regulate the counting interval. The readings are no longer in gamma ( $\gamma$ ), but are adjusted to an arbitrary base reading of 80,000 units. The reading of the movable sensor may be converted to change in  $\gamma$  by the formula:

$$\Delta H = \frac{H_F}{80,000} [N - 80,000]$$

Where  $\Delta H$  is the difference in  $\gamma$  between the fixed and movable sensors,  $H_F$  is the total field intensity (in  $\gamma$ ) of the fixed

sensor only; and N is the instrument reading. Since the total field intensity in this part of Yugoslavia is approximately 46400  $\gamma$ , in the difference mode of operations, the sensitivity of the instrument is roughly double (0.58  $\gamma$ /unit) than with one sensor only.

Since the anomalies at these sites are of the order of 100 or more  $\gamma$ , this extra sensitivity is not required, but use of the difference circuit eliminates the tedious process of correcting readings for diurnal changes. The great advantage of cesium and of other alkali vapor magnetometers over proton magnetometers is speed. The repetition interval in this instrument may be selected on the basis of desired speed of operation, from a minimum of 1.5 seconds to infinite (or manual). A built-in memory circuit "holds" the numbers when magnetic gradients are not being traversed. In practice, the readings can be viewed continuously by the operator who can see when significant anomalies are encountered and slow down to record changes in readings when anomalies are large, (~~Palo Alto, California, U. S. A.~~)

Of the two (~~Palo Alto, California, U. S. A.~~) cesium magnetometers, this one is especially suitable for (and was used for) all grids.

2. Varian Associates Portable Search Magnetometer Model  
V-4971 - Audio Type

This instrument consists also of a <sup>v</sup>Readout, one cesium

sensor, and battery pack. The big difference is with the readout. This readout is very much simplified. It contains an oscillator which can be varied with a control knob to match the Larmor frequency from the sensor. The match is made by obtaining a "null" or slow beat frequency. When this is obtained, a reading can then be taken from the calibrated dial attached to the control knob. The dial range is from 1 to 1000 and each unit is approximately equal to  $1\frac{1}{2} \gamma$ . (There is a coarser control for bringing the dial into range in any particular magnetic field). This readout is particularly suitable for doing rapid exploratory lines. One sets the dial at "null" and then while walking along, one need only listen to the change in tone to know whether or not anomalies exist. If desired, one may pause to take a reading to find out the approximate magnitude of each anomaly.

This readout, referred to later as "audio", was used for preliminary exploration, and for finding the limits of sites beyond the areas covered by grids.

#### GRID PROCEDURE

In most cases, after preliminary exploration in line<sup>s</sup> with the audio readout, grids were laid out in the areas of interest, to be covered in detail with the precision readout. For each grid, two parallel lines (one at each end of the grid) were marked with stakes at 10-meter intervals. These were located

with a tape measure. A string, calibrated in 2-meter intervals, was then strung between the end stakes of each line. The man carrying the sensor then walked along this line and paused at each two-meter marker for a reading to be taken. Upon the completion of the first line, he then moved 2 meters into the grid, along the base line, and returned parallel to the first line, but at a distance of 2 meters, again pausing at every 2-meter interval. After the completion of 3 lines, the string was moved to the next 10-meter stakes, and so on.

Each reading was called out by the man carrying the readout, and was recorded by a third person (usually, the writer) in a notebook oriented in the same direction as the grid being traversed. When finished, the pages of the notebook were then pasted together to form the complete grid.

The differential mode with 2 sensors was used for all grids. The second sensor was placed in a fixed position in the middle of each grid. (A third man carried the battery pack and also coiled and uncoiled the 100-meter cable leading to the fixed sensor as required). Grids varied in size, as shown in Tables 1, 2 and 3. A grid 60 x 100 meters in size could be covered in less than 5 hours.

After a grid had been pasted together, contour lines of equal magnetic intensity were then drawn. In these plots, "0" represents 80,000 units; 10 = 80,010 units; 990 = 79,990 units,

etc. In most grids, since the anomalies are large, contours have been drawn at intervals of 20 units, or approximately 10γ. The usual height of the sensor above the ground was 75 cm.

The average base readings differ in most of the grids. For example, in Grivac Grid #1, the average value is 0 (80,000 units) whereas in Grivac Grid #2, it is 50 units. This difference was usually caused by accidentally locating the fixed sensor on or near an anomaly. The important thing in evaluating the anomalies, however, is the change in magnitude from the average or base reading.

#### RESULTS OF CESIUM MAGNITOMETER SURVEYS

On most of the grids, good anomalies are designated "G" and doubtful ones, "D". The locations of the grids at Divostin are shown on Map 1, and the results are listed in Table 1. The work was concentrated at Divostin, but a day or more was spent at several other nearby sites as described subsequently.

#### DIVOSTIN

The best anomalies, that is, ones most likely representative of burned Neolithic house floors, were found in Grid #4. One of these has been confirmed by excavation as well as 2 other nearby ones which were detected last year by the Gomagnetski Institut (Grocka).

The total area covered by grids at 2-meter intervals in less than 14 working days was 46084 square meters. As judged

by the ~~other~~<sup>th</sup> grids without anomalies<sup>and</sup> by lines made with the audio readout, the total area of the site is approximately \_\_\_\_\_.

GRIVAC (18 Km W of Divostin)

After a preliminary trial with the audio readout indicated that many anomalies could be detected, 2 days were spent at Grivac in doing Grids #1 and #2 as well as exploratory lines. Description of the grids are given in Table 2. If the parallel rows of anomalies do truly represent rows of Neolithic houses with burned floors, these will be significant finds. In support of this, the shapes of the anomalies are much more typical of archaeological rather than geological features. Also, a sample of earth from Grivac was tested at Divostin in a place with no anomalies and was found to have negligible magnetism - a  $1\gamma$  change when 2kg of Grivac earth were held directly under a cesium sensor in a fixed position. In comparison, a similar quantity of burned clay from a house floor at Divostin caused a change of  $14\gamma$ .

In the nearby Sondas A and B (see Grid #1), Prof. Gavela and Dr. Letica (Faculte de Philosophie, Belgrade) have uncovered massive burned house floors at depths of about 1 meter. Tests over a pile of this material which had been removed from one of the excavations produced an "anomaly" of  $200\gamma$  with sensor held about 1 m above it.

Outside of the area of the grids, exploratory lines were made with the audio readout as shown on Map 2. It can be seen that the anomalies continue approximately 400 meters south of the grids and 100 m. west. The presence of grain fields prohibited exploration in other directions at this time.

#### BANJA

This is a site just off the old road from Kragujevac to Belgrade where Dr. Srejsovic found and excavated a pit which represented the starcevo culture. Unfortunately, the center of this site was right beside a transformer with many power lines leading from it. Lines made with the audio readout outside of this area had a few very small anomalies that were found in patterns typical of geological features.

#### CESTA

This site is located at Milun Dobrić/Dobrovodical (off road from Kragujevac to the Autoput). With the audio readout, a few weak anomalies were detected. The largest one was found in a small field surrounded by woods. A small grid was made (see plot) and it was found that the magnitude of the anomaly was approximately 50  $\gamma$  and its area, about 4 by 6 m. It is possible that this anomaly represents an archaeological feature.

*Test excavation - negative - a few shards.*

RAJAC

This is an early Vinca site in the hills behind Divostin, near the village of Grbice. Preliminary lines made with the audio readout indicated that there was an extensive area of large anomalies. Two grids were made as shown in Table 3. These anomalies are similar to those at Grivac, and it is anticipated that there are many Neolithic houses at this site.

SUMMARY

The areas covered by grids at 2-meter intervals are as follows:

Divostin	-	46,084	square meters		
Grivac	-	14,560	"	"	
Rajac	-	<u>8,120</u>	"	"	
Total		68,764	"	"	

Also, exploratory lines were made with the audio readout at these sites and at Banja and Česta.

Two of the good anomalies at Divostin have been confirmed by excavation. The interpretation of the anomalies will be more meaningful when combined with the information obtained from the excavations.

TABLE 1. DIVOSTIN GRID RESULTS

GRID NO.	APPROXIMATE SIZE (METERS)	GOOD ANAMOLIES	DOUBTFUL ANOMALIES	COMMENTS
1	50 x 66	5	1 very large	<p>The doubtful anomaly is very intense at its center, over 300 <math>\gamma</math>, and the anomaly is very long. It extends the whole 50-meter length of the grid. The contours of this grid were drawn originally at 10-unit intervals, but there was not space for all contours surrounding the large doubtful anomaly. Therefore, a copy was made with contours at 50-unit intervals.</p> <p>The easternmost good anomaly is from the exposed house floor in the excavation and may, therefore, be considered to have been confirmed.</p>
2	30 x 40	NONE	ALL	<p>The contours of this grid are more typical of those representative of geological features, rather than archaeological. This is seen more clearly in the second coverage with sensor height = 145 cm. Since the main features remained the same, it is likely that the causes of these magnetic variations are deeper than the usual archaeological levels.</p>
3	55 x 100	2	10	<p>The good anomaly in the SW corner looks especially promising.</p> <p>The 10 doubtful anomalies are small in magnitude and in area.</p>

4	55 x 100	5	4	This grid overlapped about half of the larger of the two grids done by Geomagnetiski Institut (Grocka) in 1968. The locations of 3 good anomalies G <sub>1</sub> , G <sub>2</sub> and G <sub>3</sub> are in exact correspondence and G <sub>4</sub> is displaced about 2 meters. The comparison was made with the Institute's plot at lower sensor height 40 cm. The cesium anomalies are, therefore, slightly less in magnitude as expected. G <sub>5</sub> and the doubtful anomalies are outside of the area covered by the Institute. G <sub>4</sub> has been confirmed by excavation.
5	44 x 142	2	4	The large good anomaly, G <sub>1</sub> , has been confirmed by excavation.
6	44 x 32		3	The 3 doubtful anomalies are of sufficient magnetic intensity, but do not have the usual anti-magnetic reactions, and their areas are small.
7	60 x 66	1		This grid was made in a small green yard surrounded by several buildings. One can see the effects from buildings, parked truck, and other smaller pieces of iron. The one good anomaly may be suspect because of this modern clutter.
8	30 x 132		1	This grid, having only one doubtful anomaly, helped to define the limits of the archaeological area.
9	24 x 132		1	This grid helped also in defining the limits of the area. The one anomaly labelled "D" is extremely doubtful.

TABLE 1. DIVOSTIN

CONT.

10	34 x 88	NONE	NONE	This grid, with no anomalies, helped to define the limits.
11	50 x 104	NONE	1	There are other anomalies that might be labelled doubtful, but it is most likely that those with very closely spaced contours are due to modern iron.
12	32 x 114		1	It is surprising that this grid, so close to G #4 and the sondas, contains no clear-cut anomalies and only one or more doubtful ones. Compared with grids completely outside of the archaeological area, however, there is "movement". That is, many rather indeterminate contours. Perhaps, these are representative of broken up or disturbed house floors.

TABLE 2. GRIVAC

GRID NO	APPROXIMATE SIZE (METERS)	GOOD ANOMALIES	DOUBTFUL ANOMALIES	COMMENTS
1	70 x 112	Many in rows		The magnitude of these anomalies is much greater than those at Divostin. Contours have, therefore, been drawn at intervals of 50 units. One sees also that the anomalies tend to be in parallel rows running roughly NW-SE. It is hoped that these represent rows of burnt house floors such as those seen in Sondas A and B (1969).
2	60 x 112	Many in rows		Same comments as for Grid #1 except that the parallel rows are not so clearly defined.

TABLE 3. RAJAC

1	34 x 140	Many		These anomalies are very large in magnitude, similar to those at Grivac. However, a pattern of parallel rows is not so clearly defined.
2	24 x 140	Many		In this grid, about 50 meters uphill from Grid #1 and parallel to it, the anomalies are smaller in magnitude and fewer. However, it is likely that several of these represent burnt house floors.

"B"

Translation  
of Mužijević's  
report

Close to the village Divostin, near Kragujevac in Yugoslavia, we have tested the possibility of applying geomagnetic methods for finding archeological objects.

Several experiments have proved the usefulness of applying geomagnetic methods for determining the places where neolithic archeological objects are under a soil-cover of different thickness.

The first experimental geomagnetic measurements applied at the places where archeologist had successfully uncovered remnants of several neolithic "houses" have shown that such "houses" can produce magnetic anomalies of the order of ten-gammas. Further on, laboratory investigations of the archeological samples have shown that the samples from the floor have magnetic susceptibility equal to  $400 \times 10^{-6}$  CGS $\mu$  units, and the intensity of remanent magnetisation equal to  $720 \times 10^{-6}$  CGS $\mu$  units; at the same time the magnetic susceptibility and intensity of remanent magnetisation of samples from an oven were  $1,400 \times 10^{-6}$  and  $1,800 \times 10^{-6}$  CGS $\mu$  units respectively. Having in mind the results of the accomplished archeological digging it was justified to assume that undiscovered archeological objects, if there were any, had to be at shallow depths up to one meter, what was very much in favor of a successful application of the geomagnetic methods. It should be mentioned that the geology of the area planned for geomagnetic measurements is rather simple: there is a thick series of lake sediments, mainly shales, sandstones, sands, clays and conglomerates of the upper myocene in age (B. Milovanović and B. Ćirić, 1968). The area planned for the geomagnetic measurements is rather small and since igneous rocks are at a great depths, it was no reason to expect magnetic anomalies due to geology of the area.

We can distinguish two types of magnetic investigation made in the field. At the northern part we made magnetic measurements along three isolated profiles. Two of them are parallel and 100 m apart, while the third is perpendicular to the two. At the southern part, near to the uncovered part of the archeological locality, we made the magnetic measurements systematically over an area of approximately 4000 meter square. In that area we made magnetic measurements along profiles 5 m apart making measurements at stations 5 m apart or less where needed. At each station we made measurements at three different levels, which were 40, 90 and 170 cm above the ground. The purpose of the three levels measurements was to reduce the ambiguity when interpreting magnetic anomalies as much as possible. At each level we measured the total intensity of the geomagnetic field using a proton magnetometer which sensitivity is 0.5 gamma.\*

\* The proton magnetometer is constructed in Geomagnetic institute, Grocka - Yugoslavia, and a crew from the same Institute made the measurements at the field.

According to the magnetic measurements there are several magnetic anomalies along the three profiles at the northern part. Among the anomalies we have selected five which at the first level, i.e. 40 cm above the ground, have intensities from 20 to 35 gammas. We had assumed that those five anomalies were due to archeological objects. However, only one of the five was verified by digging at its maximum, and it was found that the anomaly is really due to remnants of a neolithic house. In general, other anomalies which intensities are smaller (5 to 10 gammas) may be interpreted as due to the magnetic inhomogeneities of the soil (Le Borgne, 1955). Therefore, we consider that it is premature to assign them any archeological significance before digging at the places where the five earlier mentioned bigger anomalies are, and verifying their significance. When we know what the larger anomalies are due to, we can try to crosscorrelate all anomalies and give them adequate archeological significance. We can not disregard a possibility that some of the smaller anomalies are due to "fossile" ditches, since we have found a magnetic anomaly of the same order during a measurement at a place where such one ditch is partly uncovered.

Since we made the systematic measurements at the southern part of the area, it was possible to draw maps. At the maps we plotted the contour lines of equal magnetic anomalies. Altogether, three maps are plotted representing the anomalous magnetic field at each level above the ground. From the maps it may be seen that the magnetic field is very much disturbed at the investigation area. It is especially true for the map representing the anomalous magnetic field at 40 cm above the ground and at that map a very complex anomaly is obvious. There are several maximums inside of that complex anomaly. Intensities of two such maximums are 80 gammas higher than the background level of the general magnetic anomalous field. Therefore, it is assumed that such anomalous magnetic field is due to a whole complex of archeological objects. However, the distribution of the maximums inside of the mentioned anomalous zone gives a background to make a conclusion that ~~there~~ there are at least two smaller individual complexes of archeological objects as parts of the whole complex. Otherwise, geomagnetic investigations outline the "urbanistic plan" of the neolithic settlement. The filtering effect due to the increased altitude of measurement can be recognized most obviously when comparing the contour-lines of the anomalous magnetic field at different levels. Most of the details of the anomalous magnetic field which appear at the first map, i.e. at 40 cm above the ground, disappear at the level 170 cm above the ground, what obviously shows that the anomalies are due to magnetic bodies at small depths, or otherwise that the anomalies have archeological significance. We have interpreted the anomalies assuming that they were due to circular or rectangular slabs and found out that the archeological objects might be at depths from 0.2 to 1 m. under the ground. The maps were used for determining new places for digging and each digging up to this moment was positive.

next +  
GRID # 1

DIVOSTIN GRID # 5  
Sensor Height = 75 cm

Average Base Reading  $\approx$  40 units

GRIVAC GRID # 1

CONTOUR INTERVAL = 100 UNITS

1 unit  $\approx$  0.5 Gamma

Base Reading = 80,000 units  
= 0 in this plot

Sensor height = 75 cm

□ = magnetic anomalies

□ = " " " less than  
79950 units

omit  $\approx$  N ( & scale)

(Sybathis Monograph)  
Geophysics -

Cesium magnetometer grid # Divostin

# 1 RAIVAC

is Map O.K. as is

FIG. I

as FIG 1 or at  
title

at top like page 9?

Divostin Fig.

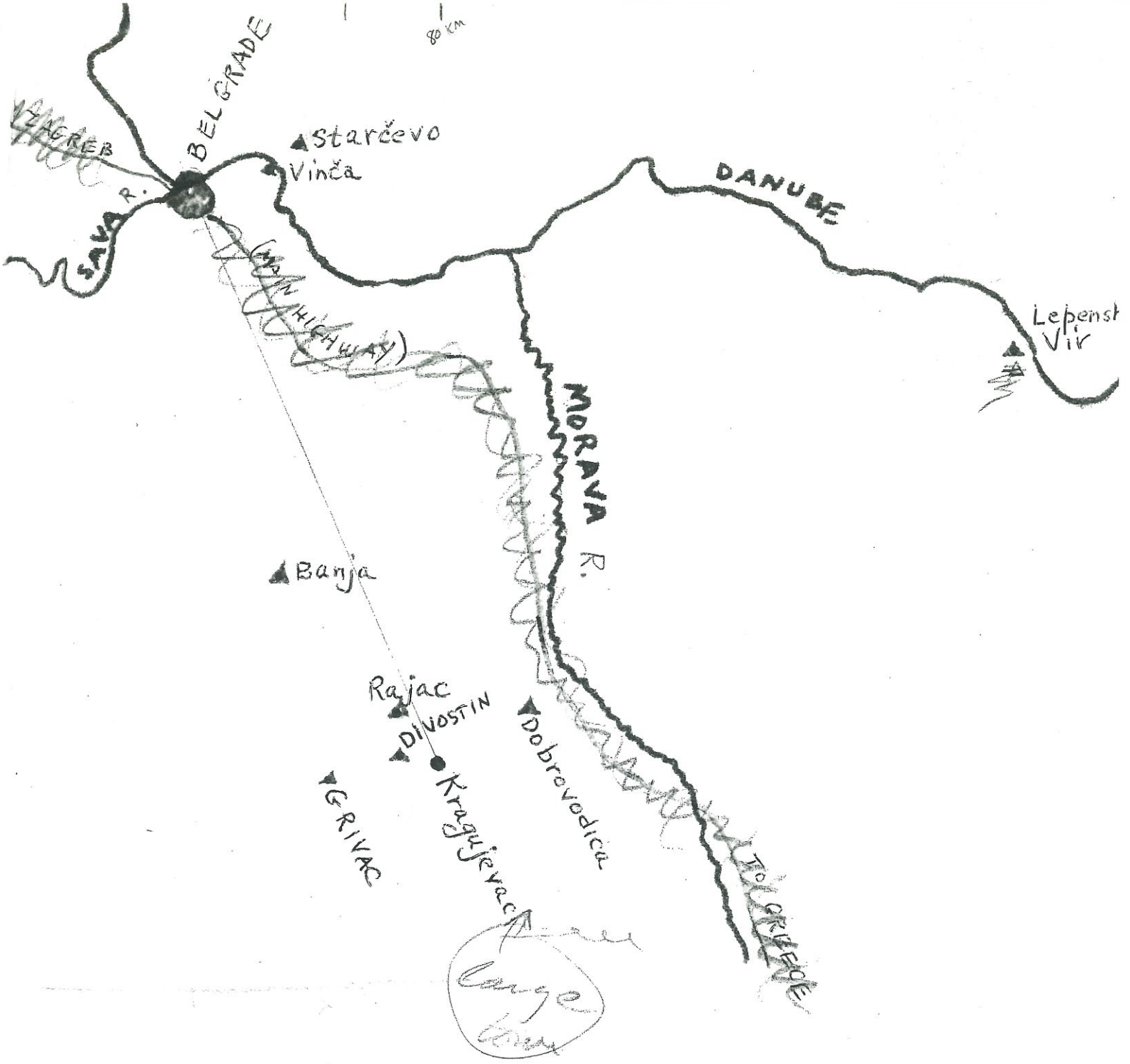
View of excavated Vinča house  
floor in foreground with typical  
rural country-side in background

grid #5

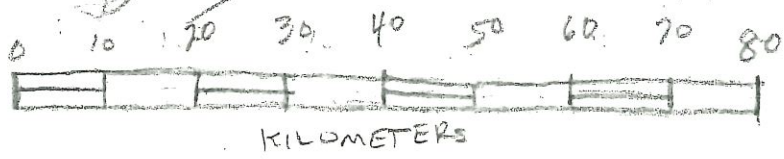
house floor 99

2 piece

Burned floor of Neolithic  
house #99 (approx. 12m long) detected by magnetometry  
in grid #5, ~~How~~



*Handwritten scribbles:*  
 ...  
 ...  
 ...



*Handwritten notes:*  
 ...  
 ...  
 ...  
 ...  
 ...  
 ...

Ralph-McPherron article

Biographical sketch of E. K. Ralph same as in Expedition, v. 7, no. 2, p. 4 with the following change and addition:

ASCA should be MASCA in the two places where it appears.

The last sentence should read: The latter endeavor has led to field trips in Italy, Ireland, Mexico and Yugoslavia.

Picture of Dr. McPherron (on left), Dr. Srejovic (on right) and student studying burned house floor at *check photo*

*FOR site name*

(If this picture is to be used with Dr. McPherron's biographical sketch, you may not wish to indicate anything except who in picture is McPherron.)

*Q. 3*  
View at Divostin of excavated <sup>or</sup> Vinca house floor in foreground with typical rural countryside in background.

*pa H*  
Divostin Grid #5, Sensor Height = 75 cm, Average Base Reading ~40 units. ( This information can be captioned or set with type right on the Grid, if this <sup>(the latter)</sup> is done there is no need to include north or scale indication as this has been incorporated into the drawing.)

*pa 5*  
Gricav Grid #1, Contour interval = 100 units, 1 unit ~0.5 gamma, Base Reading = 80,000 units, (plotted as 0), Sensor Height = 75 cm.

= magnetic anomalies

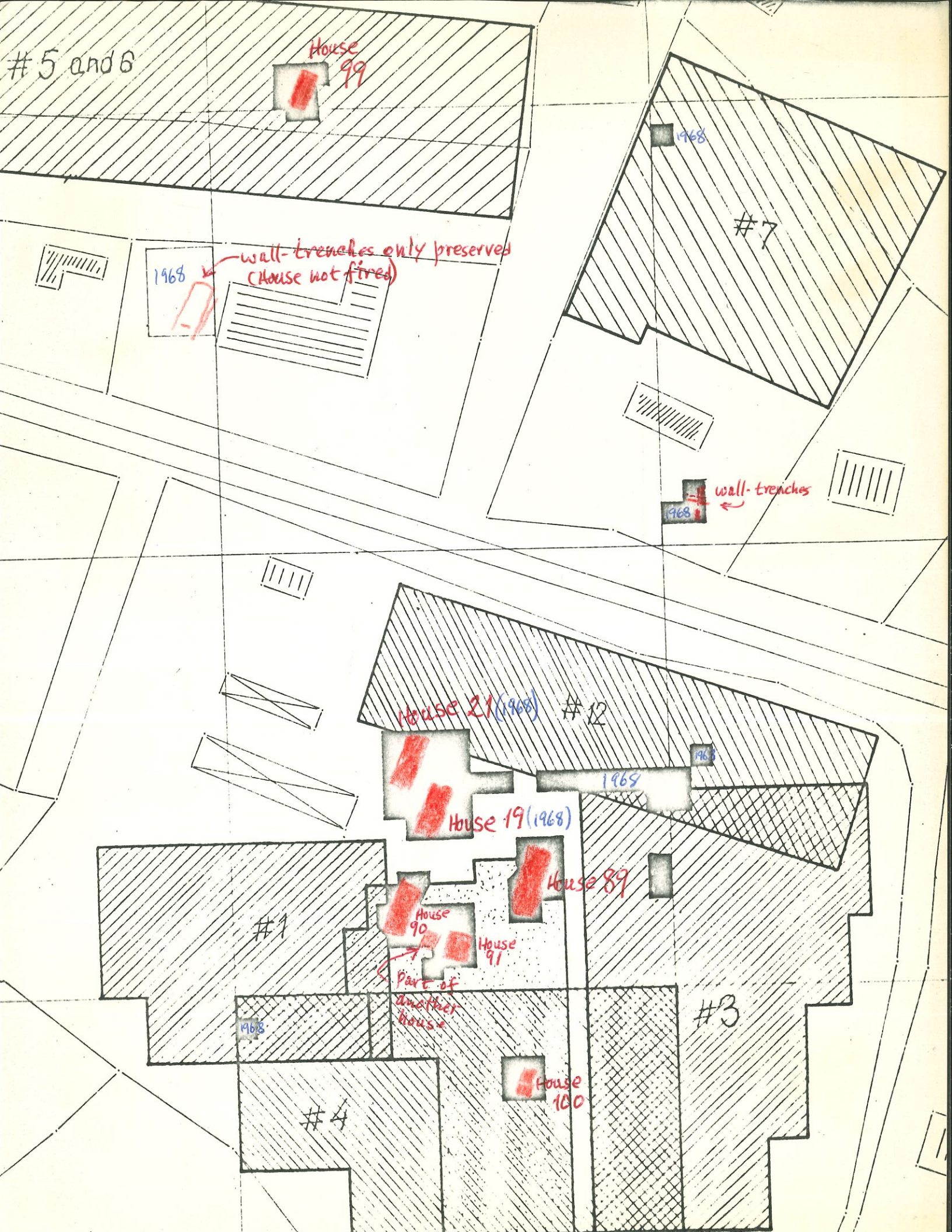
= magnetic anomalies less than 79950 units.

*(This also can be captioned or put in drawing)*

*pa 4*  
Burned floor on Neolithic house #99 (approximately 12 m. long), detected by magnetometer in Divostin #5.



Sent to PS 6/2013



#5 and 6

House 99

#7

1968

wall-trenches only preserved  
(House not fired)

wall-trenches

1968

House 21 (1968)

#12

House 19 (1968)

1969

House 89

#1

House 90

House 91

Part of  
another  
house

#3

1968

#4

House 100

*Best regards  
alan*

SEPARAT  
OFFPRINT

UNIVERZITET U BEOGRADU

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RANKO S. MUŽIJEVIĆ i ALAN Mc PHERRON  
GEOMAGNETSKA ISPITIVANJA NA JEDNOM NEOLITSKOM  
LOKALITETU U JUGOSLAVIJI

GEOMAGNETIC INVESTIGATIONS AT A NEOLITHIC SITE IN  
YUGOSLAVIA

UNIVERSITY OF BEOGRAD  
TRANSACTIONS OF THE FACULTY  
OF MINING, GEOLOGY AND METALLURGY

L'UNIVERSITÉ DE BEOGRAD  
RECUEIL DES TRAVAUX DE FACULTE  
DE MINES, DE GEOLOGIE ET DE MÉTALLURGIE

Zbornik radova Rudarsko-geološko-metalurškog fakulteta

Sv. 15 za 1972.

## Geomagnetska ispitivanja na jednom neolitskom lokalitetu u Jugoslaviji

(1 prilog)

RANKO S. MUŽIJEVIĆ<sup>1</sup> i ALAN McPHERRON<sup>2</sup>

U mesecu oktobru 1968. godine Geomagnetski institut iz Grocke izvršio je geomagnetska ispitivanja u cilju određivanja položaja ostataka kuća na lokalitetu jednog neolitskog sela. Pri tome je korišćen protonski magnetometar čija osetljivost iznosi 0,5 gama, konstruisan u samom Institutu. Arheološki lokalitet se nalazi u selu Divostinu kod Kragujevca. U vreme ovih ispitivanja već su bila počela arheološka iskopavanja od strane jedne zajedničke jugoslovensko-američke ekipe.<sup>3</sup> Dobro očuvani podovi kuća, koji pripadaju poznoj fazi kulture Vinča — Pločnik (balkanski mlađi neolit, oko 3500 godina pre nove ere) bili su upravo otkriveni. Podovi, čije su dimenzije u planu 6×15 m, bili su očigledno napravljeni od mešavine blata i slame, postavljane u drvene kalupe. U požarima je ova drvena građa dobro gorela, tako da su podovi bili pečeni i pretvoreni u postojani materijal nalik na crvenu opeku. Svaki pod je uz to sadržavao dva ili više jezgara sačinjenih od materijala sličnog keramici.

Ekipa Geomagnetskog instituta ispitala je prvo oblast gde su podovi kuća iskopavanjima bili otkriveni i pri tome su iznad podova dobijene magnetske anomalije reda 10 gama. Laboratorijskim ispitivanjem primeraka materijala iz podova utvrdilo se da taj materijal ima magnetski susceptibilitet od  $400 \times 10^{-6}$  EMJ i remanentno namagnetisanje od  $720 \times 10^{-6}$  EMJ. Ispitivanja keramici sličnog materijala iz pomenutih jezgara dala su vrednost susceptibiliteta od  $1400 \times 10^{-6}$  EMJ i remanentnog namagnetisanja od  $1800 \times 10^{-6}$  EMJ. Arheološki radovi su ukazali da dubina pokrivenih arheoloških objekata tipa podova kuća ne prelazi jedan metar. Ove okolnosti su pružale idealnu mogućnost za uspešnu primenu magnetske metode. Geološka građa okolnog terena takođe je bila po-

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<sup>3</sup> Ekipom su rukovodili dr Dragoslav Srejić sa Filozofskog fakulteta u Beogradu i drugi autor ovog rada. Istraživanja su finansirana od strane Smithsonian Institution Foreign Currency Grant №. 0592 i National Science Foundation Grant GS — 2218.

voljna, pošto pojavu magmatskih stena, koje bi mogle izazvati magnetske anomalije, ne treba očekivati na malim dubinama. Površinski deo terena u oblasti predviđenoj za magnetska ispitivanja izgrađen je od debele serije jezerskih sedimenata, koju čine laporci, peščari, peskovi, gline i konglomerati gornjeg miocena (Milovanović, Ćirić, 1968).

Na svakoj tački posmatranja magnetska merenja su izvršena na tri visine: 40, 90 i 170 cm iznad površine terena. Cilj ovakvog načina merenja bio je da se pri interpretaciji rezultata omogući što veća jednoznačnost.

Bile su korišćene dve metodologije rada na terenu. Na severnom delu lokaliteta merenja su vršena duž izolovanih profila. Na južnom delu lokaliteta, u blizini mesta gde su podovi kuća već bili otkopani, izvršeno je sistematsko ispitivanje na površini od oko 4000 m<sup>2</sup>, na mreži profila sa tačkama posmatranja na rastojanju od 5 m ili manjem, ukoliko je to bilo potrebno.

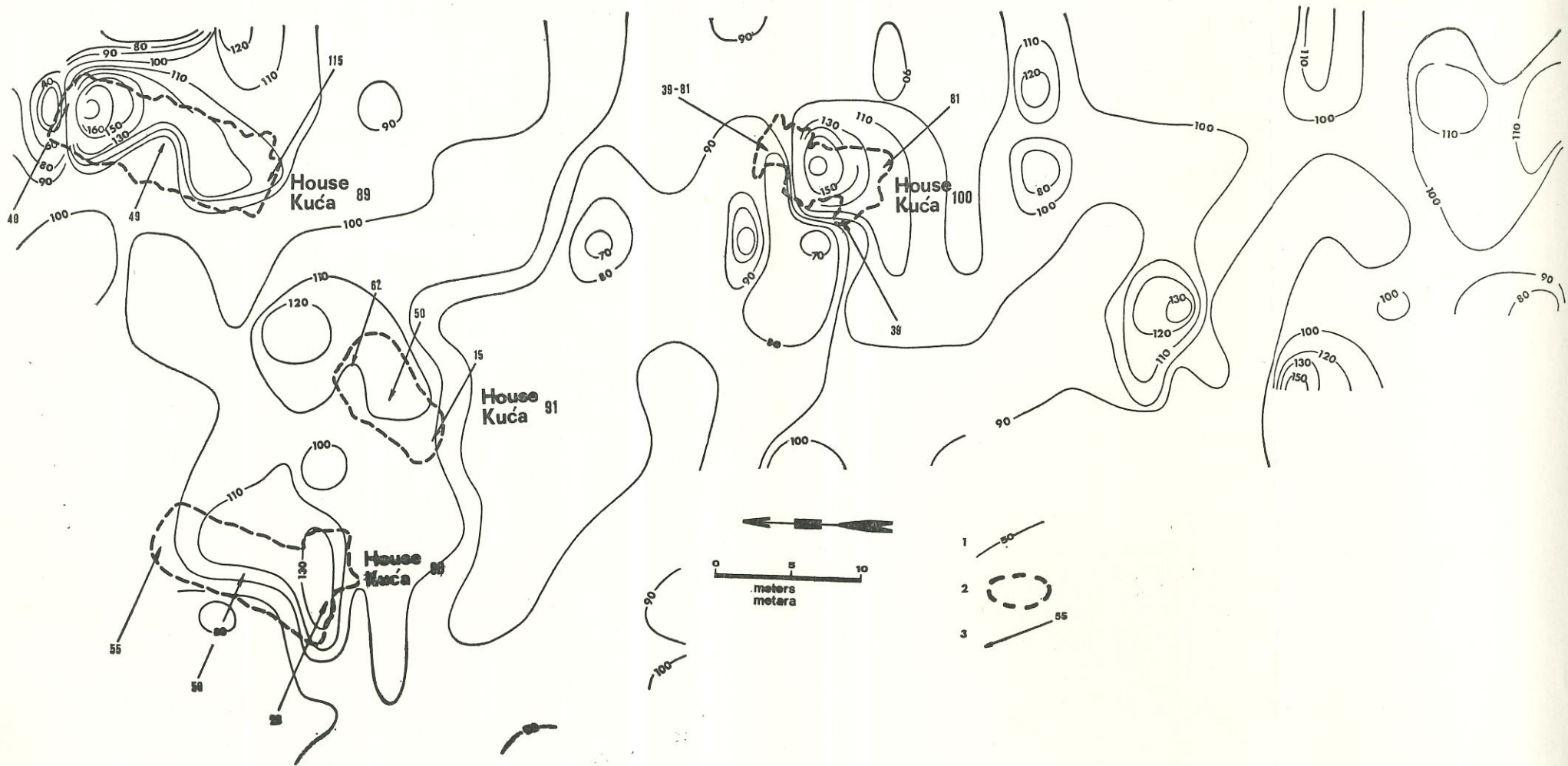
Merenja na severnom delu ispitanog terena ukazala su na više anomalija. Od pet anomalija, čije su vrednosti pri merenju na visini od 40 cm iznosile od 20 do 35 gama i koje su označene kao arheološki interesne, do sada je samo jedna proverena otkopavanjem i utvrđeno je da je zaista izazvana podom jedne kuće. Dok neke od anomalija manjeg intenziteta (5 do 10 gama) mogu bez sumnje da se pripisuju nehomogenosti površinskog sloja (Le Borgne, 1955), druge mogu da predstavljaju neolitske jame i jarke, kakvi su pri otkopavanju već nađeni. Verifikacija ovakve mogućnosti u Divostinu pomoću magnetskih merenja izvršena je, međutim, samo na jednom mestu, gde su postojanje i položaj jednog dela neolitskog jarka već bili utvrđeni. Na tom mestu dobijene su magnetske anomalije veličine od 5 do 10 gama.

Merenja izvršena na mreži profila na južnom delu lokaliteta omogućila su da se iscrtaju izololinije intenziteta totalnog vektora geomagnetskog polja. Načinjene su posebne karte za svaku od tri visine merenja iznad površine terena (Jelić, 1968). Karta dobijena iz merenja na visini od 40 cm, koja je prikazana na slici 1, pokazuje više naglašanih anomalija. Docnija otkopavanja su pokazala, kao što se i očekivalo, da te anomalije izazivaju podovi kuća, čije su konture na slici izvučene isprekidanim linijama.

Filtarsko dejstvo povećanja visine merenja vidi se vrlo lepo kada se uporede karte izololinija dobijene pri različitim visinama merenja. Mnogi detalji anomalijskog magnetskog polja, koji se javljaju na karti koja odgovara merenjima na 40 cm iznad površine terena, iščezavaju na karti koja odgovara visini od 170 cm, što ukazuje na malu dubinu uzročnika anomalija. Polazeći od pretpostavke da uzročnici anomalija imaju oblik kružnih diskova, odnosno pravougaonih ploča, sračunate su dubine do takvih uzročnika na mestima docnije otkopanih kuća 89 i 100 i našlo se da se te dubine kreću u granicama od 0,2 do 1,0 m (Mužijević, 1969).

Osnovni cilj ovih geomagnetskih ispitivanja bio je da se omogući što efikasniji izbor mesta za arheološka iskopavanja na ovom lokalitetu. Probna iskopavanja na mestima anomalija većih od 20 gama potpuno su potvrdila pretpostavku da su podovi kuća uzročnici anomalija. Tako se pokazalo da se na lokalitetima sa takvim arheološkim objektima kao





Sl. 1. Plan izolinija intenziteta totalnog vektora geomagnetskog polja.  
Po Ž. Jeliću, 1968.

1. izolinije; 2. konture otkrivenih podova kuća; 3. dubina podova kuća po arheološkim podacima.

Fig. 1. Contour lines of the total Earth's magnetic field. After Ž. Jelić, 1968.

1. contour lines; 2. contours of excavated house floors; 3. depth to an excavated house floor,

što su pečeni podovi kuća može pre arheoloških radova izvršiti geomagnetsko kartiranje, čija neposredna arheološka provera omogućava projektovanje arheoloških iskopavanja na osnovu proširivanja zaključaka, dobijenih pomoću utvrđenog uzorka, na čitav ispitivani teren.

#### SUMMARY

### GEOMAGNETIC INVESTIGATIONS AT A NEOLITHIC SITE IN YUGOSLAVIA

by

RANKO S. MUŽIJEVIĆ and ALAN MCPHERRON

In October 1968, the Geomagnetic Institute at Grocka, Yugoslavia, located and mapped house remains at a Neolithic village site, using a proton magnetometer of 0.5 gamma sensitivity constructed at the Institute. The archeological site is located at Divostin near the city of Kragujevac, about 100 km S of Belgrade, and was then under excavation by a joint Yugoslav-American team. Well-preserved house floors pertaining to a late phase of Vinča-Pločnik (Balkan Late Neolithic, about 3500 B. C.) were being recovered. The floors, up to 6×15 m in plan, had evidently been constructed of a mud and straw mixture packed onto a bed of split timbers laid on the ground. The timber subfloors provided both fuel and draft when houses burned, with the result that floors were baked into an imperishable brick-red material. Each floor also contained two or more hearths constructed of a ceramic-like material.

A crew from the Geomagnetic Institute first tested areas where excavation had uncovered house floors, obtaining magnetometer readings over the floors in the order of 10 gammas. Laboratory measurements of samples of the floor material indicated magnetic susceptibility of  $400 \times 10^{-6}$  EMU. Measurements of the ceramic-like hearth material yielded susceptibility of  $1400 \times 10^{-6}$ , and intensity of remanent magnetization of  $1800 \times 10^{-6}$  EMU. The archeological work indicated that the depth of buried archeological features such as house floors should not exceed 1 m, providing an ideal situation for the successful application of geomagnetic methods. Subsurface geology was also favorable in that igneous rocks that might cause magnetic anomalies were deeply buried. Immediate subsurface deposits in the limited area to be surveyed consist of a thick series of lake sediments, mainly shales, sandstones, sands, clays, and conglomerates of the Upper Miocene.

The field procedure followed was to take three magnetometer readings at each station: at 40, 90, and 170 cm above ground surface. Our purpose in measuring at three heights was to reduce uncertainties in interpretation that could result when anomalies are due to bodies occurring at different unknown depths.

Two survey techniques were used. At the northern half of the site, we measured along three isolated profiles. At the southern half of the site, near the area where house floors were being excavated, we syste-

matically surveyed an area of about 4000 m<sup>2</sup>, using a grid pattern and taking readings every 5 m, or even more frequently where required.

The measurements in the northern half revealed several anomalies along the three profiles. Of five anomalies whose intensities at the 40 cm elevation ranged from 20 to 35 gammas, and which were thought to be houses, one was verified by excavation and found to be in fact a house floor. While some anomalies with lower intensities (5–10 gammas) can no doubt be ascribed to the magnetic inhomogeneities of the soil, others may represent Neolithic pits and ditches, of which many were found in excavation. The only verification of this at Divostin, however, has come from magnetometer measurements of unexcavated portions of a ditch, whose existence and position was known from the portions encountered in an excavation unit. It yielded magnetic values of the order 5–10 gammas.

The measurements taken in grid fashion at the southern half were mapped and contour lines of equal magnetic intensity plotted. A separate map was prepared for each of the three heights above the ground at which readings were taken. The map of readings at 40 cm height (Figure 1) shows the most pronounced anomalies. In the figure, isolines of equal magnetic intensity plotted before digging are seen to correspond with the house floors recovered in excavation, shown as dashed lines.

The filtering effect seen with increasing height of measurement above the ground is evident when contours of the same anomalies are compared on maps representing the different heights. Most details of the anomalous magnetic field that appear on the 40 cm map are no longer seen on the 170 cm map, indicating that the anomalies result from magnetic bodies at shallow depths. Applying a model that assumes that the anomalies represent buried circular or rectangular slabs, we calculated that they should occur at depths of 0.2 to 1.0 m below the surface, and at those places the houses 89 and 100 were recovered in excavation after the magnetic measurements.

The major purpose of mapping is to permit more effective archaeological sampling of the site. Test excavation of anomalies stronger than 20 gammas has consistently confirmed that anomalies represent house floors. Thus, by such a combination of geomagnetic and archaeological techniques a site with such seldom-encountered features as fired house floors can be mapped prior to excavation, permitting the generation of a sampling design for excavation and the extension of the results to the anomalies on the site as a whole.

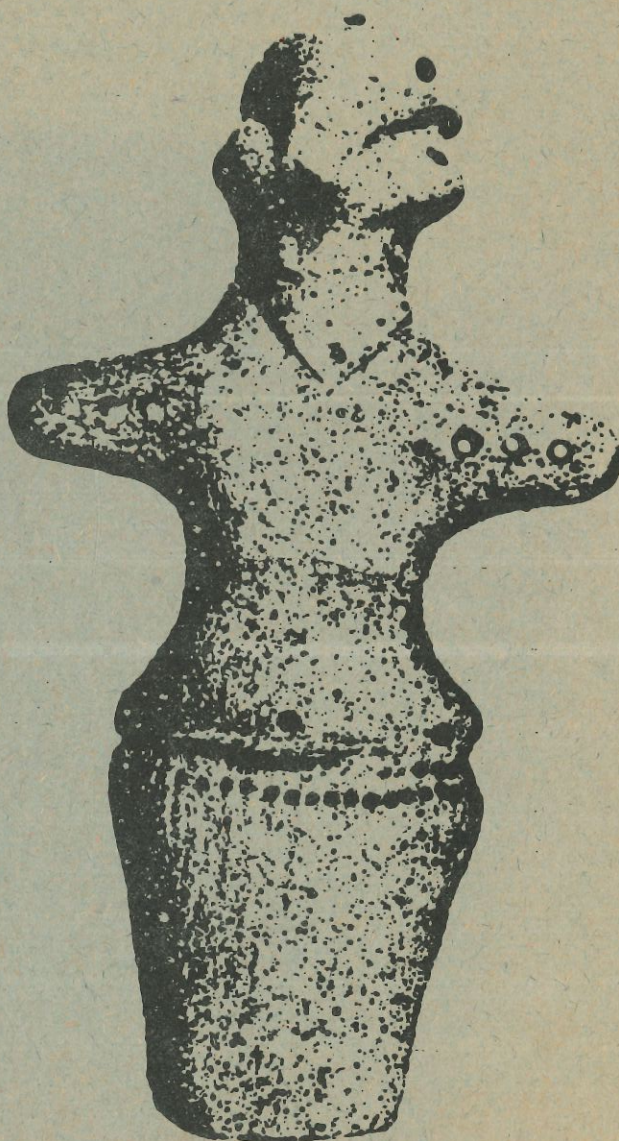
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Štampa: Graf. pred. »Radiša Timotić«, Beograd, Jakšićeva 9

File in MASCA "Yugoslav  
Survey"

**EARLY FARMING CULTURES  
IN CENTRAL SERBIA  
eastern yugoslavia**



**National Museum of Kragujevac**

Best regards  
Alan  
rec'd 11/72

E A R L Y F A R M I N G C U L T U R E S  
I N C E N T R A L S E R B I A  
( E A S T E R N Y U G O S L A V I A )

PRELIMINARY REPORT  
and  
Guide to an exhibit in the National Museum of  
Kragujevac.

September, 1971.

Text: A. Mcpherron, D. Srejović.

Exhibit: M. Bogdanović, M. Jerinić,  
A. Mcpherron, D. Srejović.

PROJECT "DIVOSTIN"

A joint Yugoslav-American project for the study of neolithic cultures in Central Serbia was organized in 1968 by Dr. Alan Mcpherron (Dept. of Anthropology, Univ. of Pittsburgh, USA) and Dr. Dragoslav Srejovic (Philosophical Faculty, Belgrade Univ., Yugoslavia). The cooperating institutions are the University of Pittsburgh and the National Museum of Kragujevac. Financial support is provided by the Smithsonian Institution and the National Science Foundation in Washington, D.C., USA.

The goals of the project are:

1. Explication of cultural and natural changes that occurred between early neolithic (Starčevo) and late neolithic (Vinča) times in the area;
2. Study of technology, economy, and environment;
3. Improvement of local chronology, especially through C-14.

Systematic excavations were conducted at Divostin (Fig. 1), a village about 7 km. w. of the city of Kragujevac, where about 2250 m<sup>2</sup> of surface area were opened in 1968/69. Several other sites in the vicinity were also tested. The chronology based on C-14 dating is shown in Figure 2, and will be discussed later in this report.

Both the modern and the neolithic settlements at Divostin are situated on heavy, clayey, and fertile soil known as "Smonitsa." The site is located on a spring line, with several permanent springs below the slope on which the site is situated.

The existence of the prehistoric site was known for many years. Digging of a house-cellar in 1956 brought to light a group of complete Vinča-Pločnik figurines (see cover), evidence of a fired house floor, and other artifacts. A test excavation conducted by the Kragujevac museum showed the site

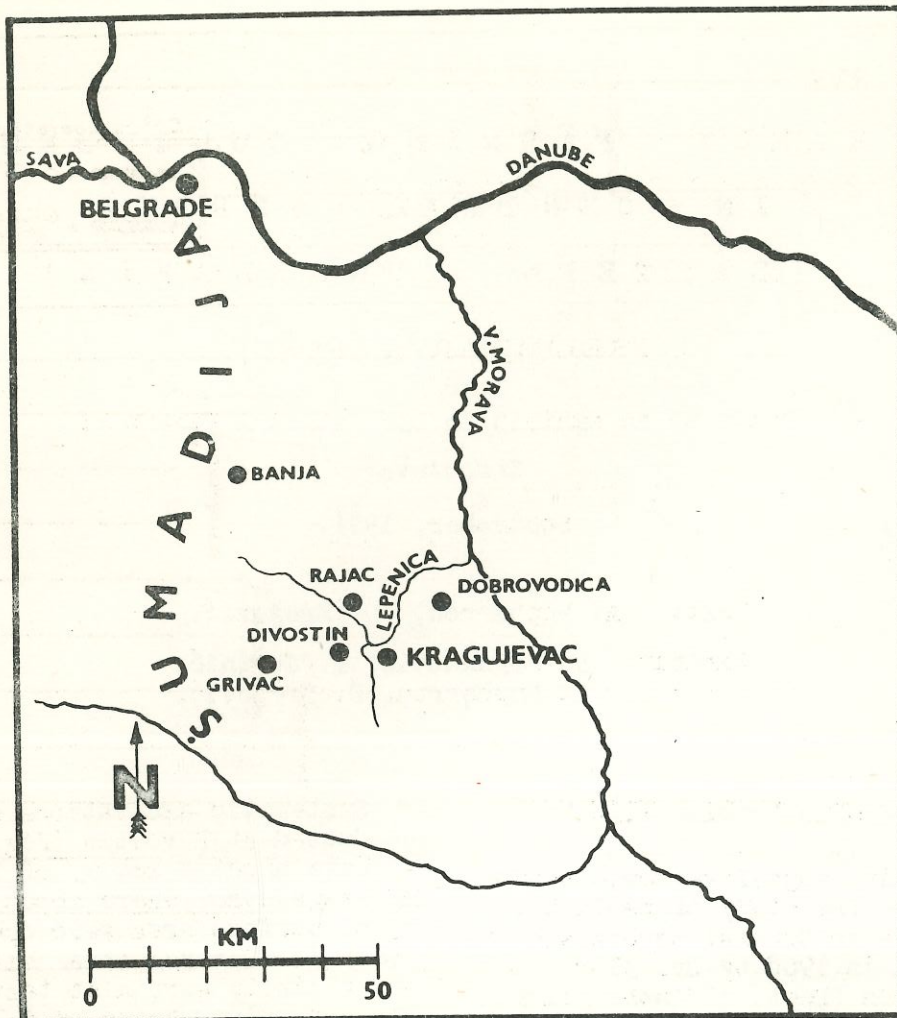


Figure 1. Map of Central Serbia, showing sites excavated by Project.

to have been occupied during the Starčevo and late Vinča-Pločnik phases of the Serbian prehistoric sequence. The systematic excavations showed that the site was unoccupied except during these two phases, and that the Vinča phase could further be subdivided into two occupations. The total extent of the site is about 50 hectares.

#### STRATIFICATION AT DIVOSTIN

Cultural deposits at Divostin are shallow; the top of the occupation layer occurred at an average depth of about 40 cm below

surface. The burnt mud-and-chaff floor of one of the best-preserved houses (Feature = "Objekt" no. 99) was found only 30 cm below ground surface. Even the bottoms of the deepest pit. were rarely deeper than 1.5 m. The occupation layer itself could equally consist of Vinča or Starčevo features, for despite the fact that nearly 2000 years separated the two occupation phases, vertical separation of them on the site was very rare. It appears either that there was no soil deposited between the two phases, when the site was unoccupied, or else that erosion prior

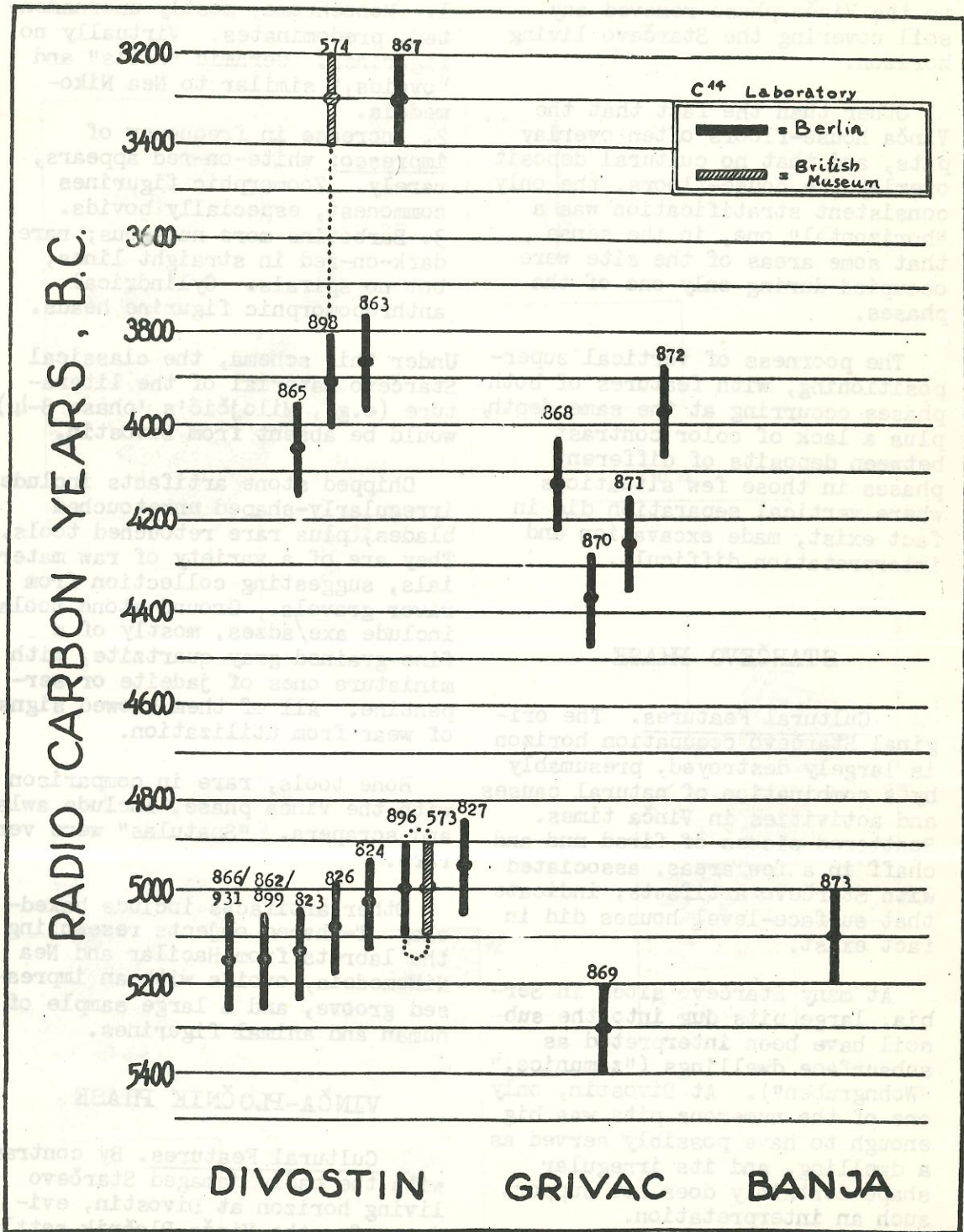


Figure 2. C-14 dates.

to the Vinča phase removed any soil covering the Starčevo living horizon.

Other than the fact that the Vinča house-floors often overlay pits, and that no cultural deposit overlay the house-floors, the only consistent stratification was a "horizontal" one, in the sense that some areas of the site were occupied during only one of the phases.

The poorness of vertical superpositioning, with features of both phases occurring at the same depth, plus a lack of color contrast between deposits of different phases in those few situations where vertical separation did in fact exist, made excavation and interpretation difficult.

### STARČEVO PHASE

Cultural Features. The original Starčevo occupation horizon is largely destroyed, presumably by a combination of natural causes and activities in Vinča times. Scattered pieces of fired mud-and-chaff in a few areas, associated with Starčevo artifacts, indicate that surface-level houses did in fact exist.

At many Starčevo sites in Serbia, large pits dug into the subsoil have been interpreted as subsurface dwellings ("zemunice," "Wohngruben"). At Divostin, only one of the numerous pits was big enough to have possibly served as a dwelling, and its irregular shape certainly does not support such an interpretation.

Starčevo Artifacts. The ceramics suggest to D. Srejović that, on typological grounds, three subphases within the Starčevo phase might be distinguished. From earliest to latest, they would be characterized as follows:

1. Monochrome, mostly unornamented, predominates. Virtually no figurines. Ceramic "nails" and "ovoids," similar to Nea Nikomedeia.
2. Increase in frequency of impresso; white-on-red appears, rarely. Zoomorphic figurines commonest, especially bovids.
3. Barbotine more numerous; rare dark-on-red in straight lines, but no spirals. Cylindrical anthropomorphic figurine heads.

Under this schema, the classical Starčevo material of the literature (e.g., Milojčić's 'phase 3-4') would be absent from Divostin.

Chipped stone artifacts include irregularly-shaped unretouched blades, plus rare retouched tools. They are of a variety of raw materials, suggesting collection from river gravels. Ground-stone tools include axe/adzes, mostly of a fine-grained gray quartzite, with miniature ones of jadeite or serpentine. All of them showed signs of wear from utilization.

Bone tools, rare in comparison with the Vinča phase, include awls and scrapers. "Spatulas" were very rare.

Other artifacts include baked-clay T-shaped objects resembling the labrets from Hačilar and Nea Nikomedeia, ovoids with an impressed groove, and a large sample of human and animal figurines.

### VINČA-PLOČNIK PHASE

Cultural Features. By contrast with the badly damaged Starčevo living horizon at Divostin, evidence for the Vinča-Pločnik settlement is well preserved in the form of fired mud-and-chaff house floors. Excavations yielded 7 complete and 10 incomplete floors, as well as compact layers of stone and cultural materials, and a number of pits of various dimensions. Figure

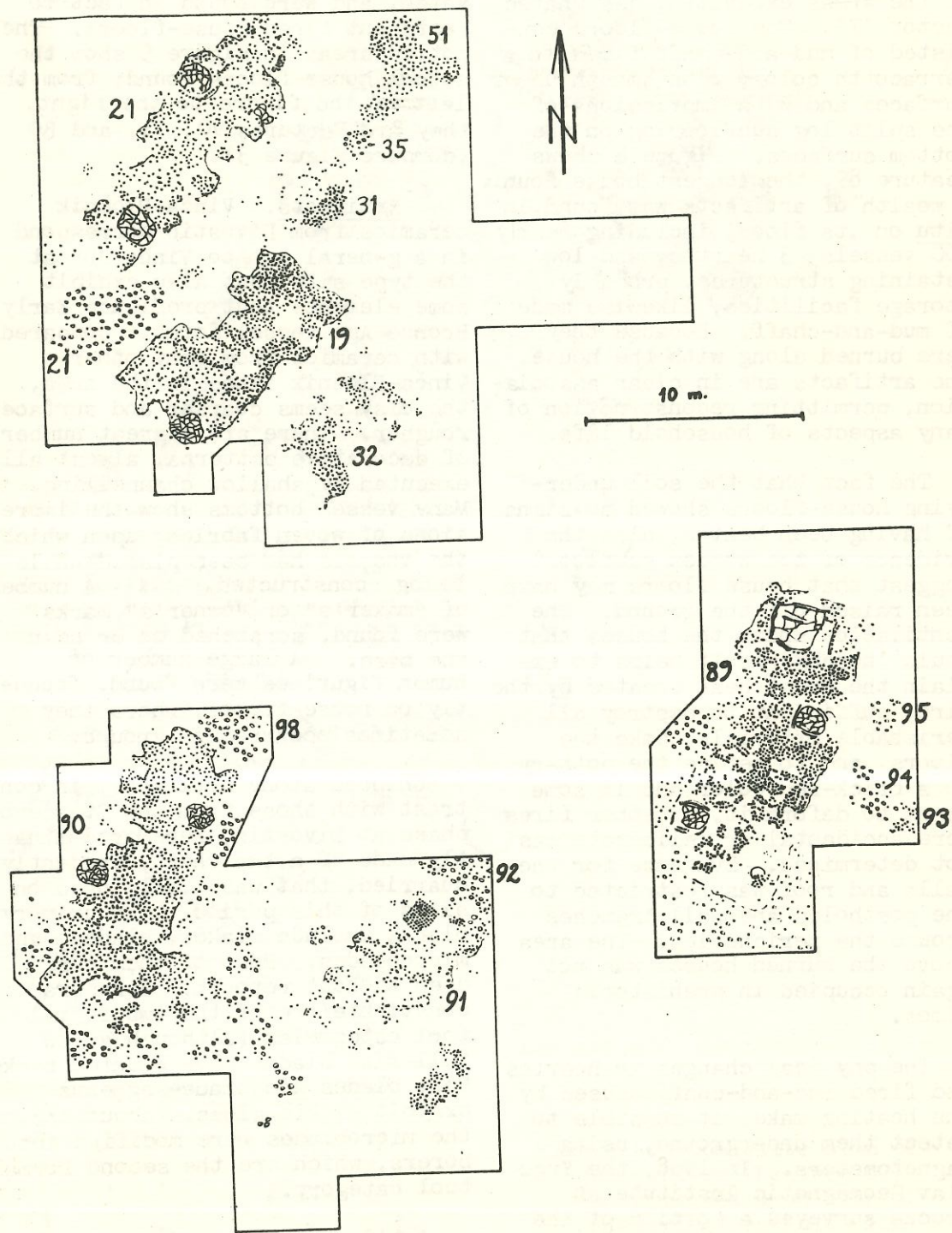


Figure 3. Areas excavated in Sector F at Divostin, showing principle cultural features of the Vinča-Pločnik phase.

3 shows the house-floors (fired chaff-and-straw represented by dots) and areas of compact cultural material (circles) located in one of the areas excavated, designated Sector 'F'. The house-floors consisted of mud-and-chaff fired to a terracotta color, with smooth upper surfaces and with impressions of the split log subflooring on the bottom surfaces. Figure 4 shows Feature 89, the longest house found. A wealth of artifacts was found in situ on its floor, including nearly 100 vessels, 3 hearths, and low retaining structures, probably storage facilities, likewise made of mud-and-chaff. Because they were burned along with the house, the artifacts are in clear association, permitting reconstruction of many aspects of household life.

The fact that the soil underlying house-floors showed no signs of having been heated, plus the evidence of the wooden subfloor, suggest that house floors may have been raised off the ground. The ventilation under the houses that would thereby result helps to explain the great heat created by the fire, sufficient to destroy all perishable materials, bake the floors, and to refire the pottery to a brick-red color and in some cases to deform it. Whether fires were accidental or deliberate was not determined. Evidence for the walls and roof was restricted to the postholes and wall trenches around the peripheries. The area above the burned houses was not again occupied in prehistoric times.

The physical changes in hearths and fired mud-and-chaff caused by the heating makes it possible to detect them underground, using magnetometers. In 1968, the Yugoslav Geomagnetic Institute at Grocka surveyed a portion of the site with a proton magnetometer. Figure 5 is a map of the resulting isolines of equal magnetic intensity. Crowded lines representing

"anomalies" (areas of high magnetic intensity) can be seen in a number of places. In the second field season, such anomalies were excavated, and were found in fact to represent fired house-floors. The dotted areas in Figure 5 show the actual house-floors found; from the left of the figure to the right, they are Features 90, 91, and 89 (compare Figure 3).

Artifacts. Vinča-Pločnik ceramics from Divostin correspond in a general way to Vinča "D" at the type site, but also exhibit some elements that prefigure Early Bronze Age vessel forms. Compared with ceramics from many other Vinča-Pločnik sites in the area, the clay seems coarser and surfaces rougher. There are a great number of decorative patterns, almost all executed by shallow channelling. Many vessel bottoms show the impressions of woven fabrics, upon which the vessels had been placed while being constructed. A number of "maker's" or "owner's" marks were found, scratched on or near the base. A large number of human figurines were found, frequently on house floors, where they sometimes occurred in groups.

Chipped stone artifacts, in contrast with those from the Starčevo phase at Divostin, were predominantly made of a tan chert, evidently quarried, that was widely used on sites of this period. The primary blanks include flakes, blades, and microblades. Most of them were used without retouch. Scrapers constitute one of the two formal tool categories (although a few full-size blades have blunted backs). Many blades and blade-segments exhibit sickle gloss. About 1/3 of the microblades were modified into borers, which are the second formal tool category.

Artifacts of ground stone, about 500 in all, include various axe/adze and gouge forms. A large proportion were made of a light, soft, stone

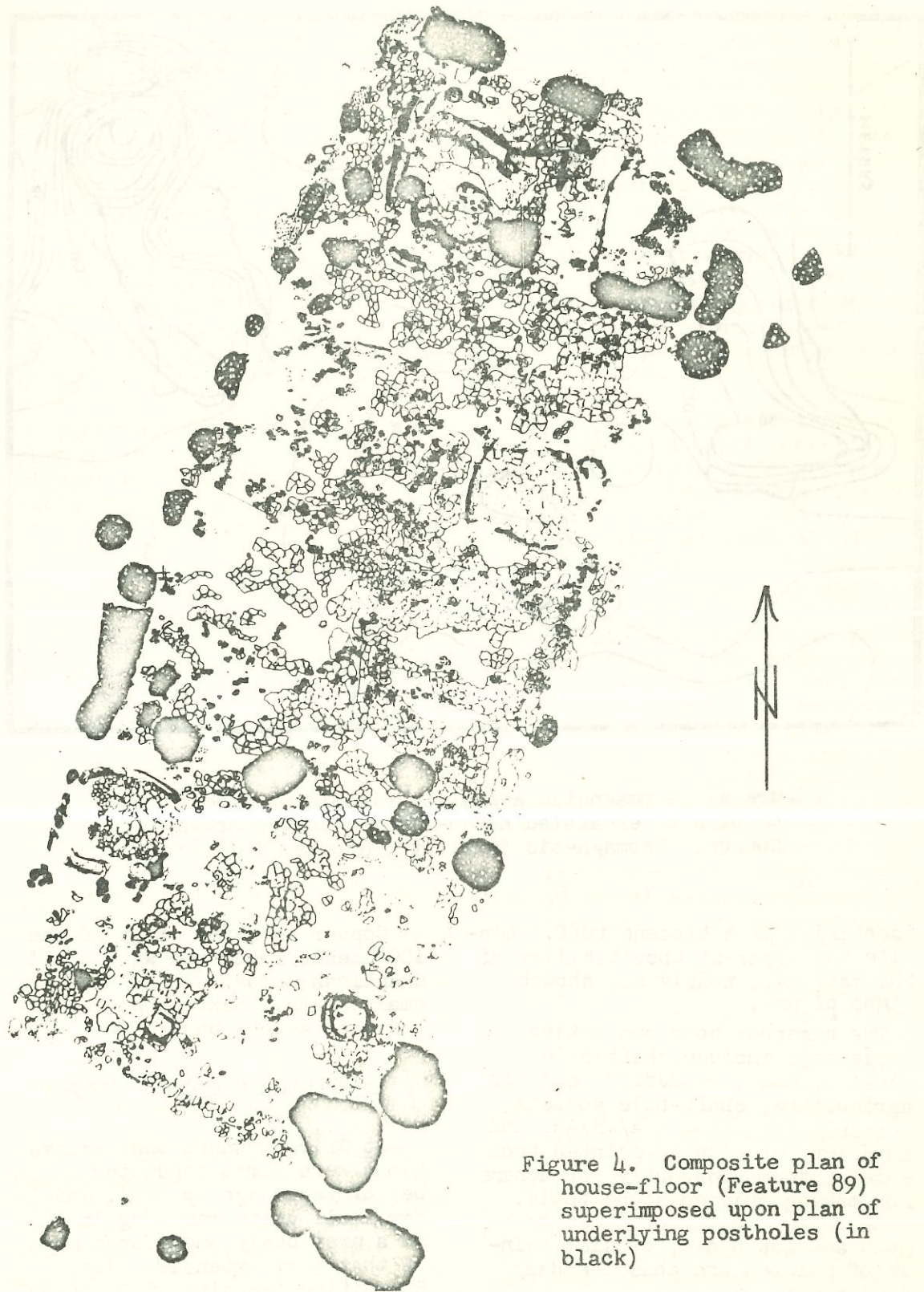


Figure 4. Composite plan of house-floor (Feature 89) superimposed upon plan of underlying postholes (in black)

5 m.

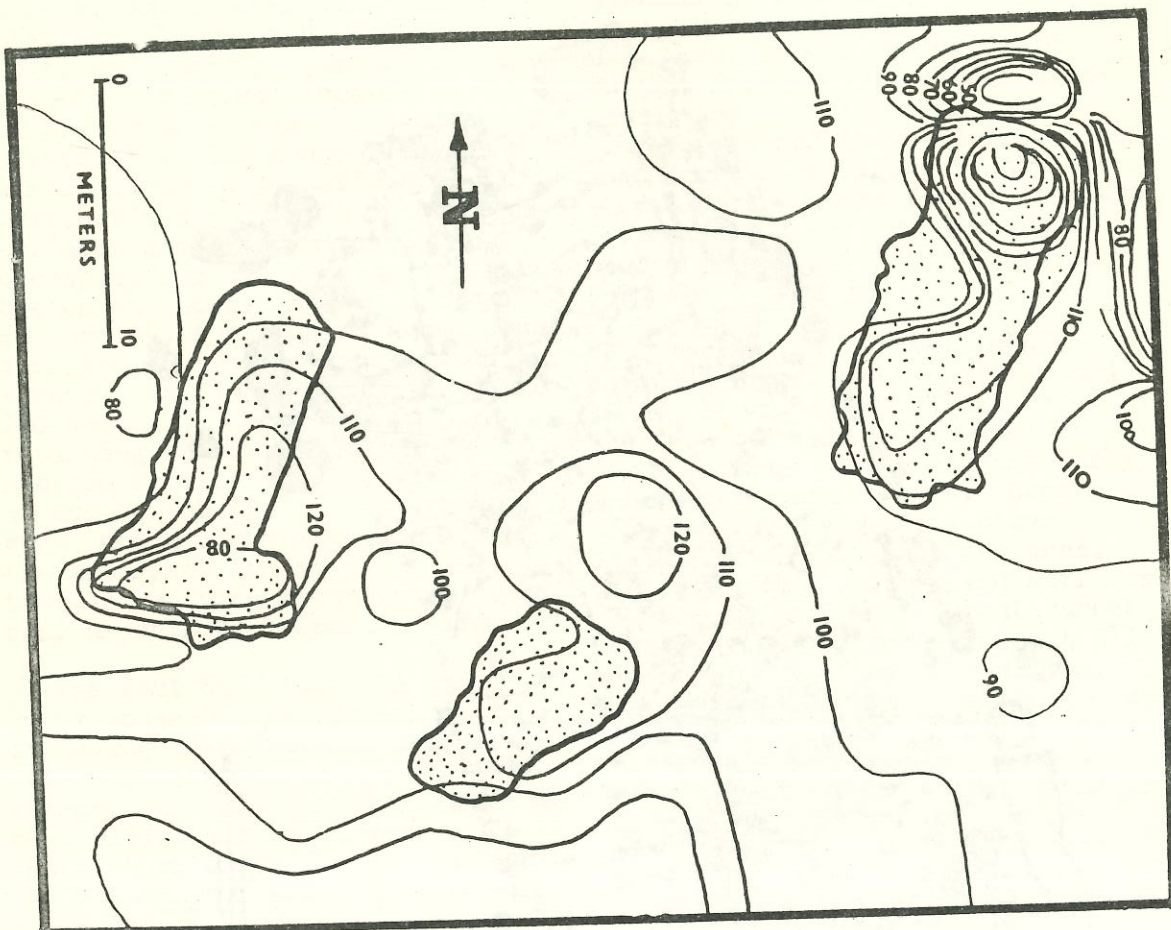


Figure 5. Geomagnetic anomalies (isolines) superimposed on plan of excavated house-floors (dotted areas).  
Source: Geomagnetic Institute, Grocka, Yugoslavia.

identified as a Miocene tuff. Despite the apparent unsuitability of the material, nearly all showed signs of use.

The numerous bone and antler implements include shaft-hole picks or hoes, evidently used for agriculture, shaft-hole sockets possibly for stone axe/adzes, and a variety of bluntly pointed tools, some of them apparently retouchers for making chipped stone tools. Bone tools, mostly of sheep or goat and cow bones, consist mainly of pointed and chisel-ended implements.

Copper is rare; most of the 100 pieces recovered were small shapeless lumps. There were 12 small beads. Sixteen pieces of obsidian were found.

#### TESTING OF OTHER SITES

At Grivac, where test excavations were first conducted a number of years ago by Prof. Gavela, two small units were dug in 1969 in a previously unexplored part of that very extensive site. Stratified deposits of Starčevo and Vinča were encountered, including 2 building phases of

Vinča with fired house floors. These 2 Vinča-Pločnik phases were both typologically earlier than Divostin, and should correspond approximately to Vinča "C-1" and "C-2." Grivac artifacts in general seem considerably more ornate and stylistically sophisticated than those from Divostin.

At Kusovac, a brief test excavation yielded 2 building levels of Vinča-Pločnik, and, in the lowest levels, ceramics that appear transitional between Starčevo and Vinča.

Dobrovodica and Banja are both pure Starčevo sites with single occupation deposits. Their artifacts are very similar to those from Divostin-Starčevo.

All four Starčevo occupations--Divostin, Grivac, Dobrovodica, and Banja--yielded areas with scattered pieces of fired mud-and-chaff from walls and/or floors, indicating that, as is the case on many sites of this period in the Balkans, surface-level houses were the normal kind of habitation. Large pits were found beneath those areas where the fired mud-and-chaff was preserved. It is suggested that burned Starčevo houses were ordinarily destroyed by weathering, especially if no soil wash quickly covered them. Above pits, however, settling of pit fill lowered the house material into shallow depressions, where the fired mud-and-chaff was preserved.

Compared with the Vinča house floors at Divostin, the Starčevo ones appear to have been much less massive, perhaps less permanent. One is led to conclude, from this and other kinds of evidence, that the mode of settlement was quite different in the two phases.

## CHRONOLOGY

C-14 Dating. Radiocarbon age-estimates are shown in Figure 2, using standard half-life and without "calibration." The single Grivac date is the earliest at present for a Starčevo site, and the cluster of Starčevo dates, as a whole, is early by comparison with other Starčevo-Körös dates. It is reasonable to accept that the dates represent essentially a single event in time.

The age-estimates for the Vinča-Pločnik phase at Divostin present a problem, in that three (Bln-863, 865, 898) seem much too early on the basis of ceramic typology. The two dates at 3300 B.C. (Bln-867, BM-574), however, appear to be correct. The fact that Bln-898 and BM-574 are measurements of portions of the same sample makes the discrepancy even harder to explain. More samples from Vinča contexts at Divostin are currently being dated.

The series of age-estimates for Grivac appears to be generally reasonable.

Archeomagnetic Dating. Samples of hearth material and fired mud-and-chaff flooring were submitted to Dr. Buchá's laboratory in Prague. His results, which at present have only a relative-chronological significance, show that, while Starčevo and Vinča can be easily distinguished on the basis of magnetic intensity, the individual Vinča houses cannot be placed in a temporal sequence. However, since the undisturbed hearths in house floors are ideally suited to this method of dating, it is hoped that further work, particularly that based on measurements of magnetic inclination and declination,

will make it possible to date the individual houses, or to determine whether they were destroyed by a single fire.

Thermoluminescence Dating. Provisional results of measurements in Dr. Aitken's laboratory at Oxford on ceramics from Divostin yielded a value of 6190 B.C.  $\pm$  800 for Starčevo potsherds from Pit 120, for which the C-14 age-estimate was 5000 B.C.  $\pm$  100 (Bln-896). A value of 4920 B.C.  $\pm$  700 was obtained for Vinča potsherds from Pit 121, for which the C-14 age-estimates were 3910 B.C.  $\pm$  100 (Bln-898) and 3297 B.C.  $\pm$  100 (BM-574). While the thermoluminescence value for the Starčevo pit is reasonably close to the bristlecone-pine calibrated C-14 date, the value for the Vinča pit seems impossibly early.

Obsidian-Hydration Dating. The 16 pieces of obsidian from Divostin were analyzed at Dr. J. Michels' laboratory, Pennsylvania State University. The hydration bands varied widely, and no correspondence between thickness of band and archeological phase could be ascertained.

#### OTHER SPECIALIST STUDIES

Magnetometer Mapping of Village Plans. In the 1968 field season, the Geomagnetic Institute surveyed a portion of Divostin and found that fired house-floors could be detected prior to excavation. In 1969, Miss Elizabeth Ralph (Univ. of Pennsylvania Museum), using a cesium magnetometer, mapped magnetic anomalies on most of Divostin and a part of Grivac, and tested a number of other sites. The results on all pure Starčevo sites were negative, but were favorable on all Vinča sites tested. Spectacular results were obtained at Grivac (Fig. 6). If we assume that the strong ano-

malies shown in the figure represent burned house floors, as seems justified on the basis of the results at Divostin, and the two floors found at Grivac, then we may interpret the figure as showing a striking and orderly pattern of houses aligned in rows. Magnetometer survey is clearly of value in site-mapping, where such house-floors and hearths are present, both for obtaining a rapid picture of the distribution of houses, and for providing a guide for excavation.

Botanical Investigations. Drs. H-J. Beug and E. Gröger (Göttingen) visited the Kragujevac area in 1970, and took samples for analysis of pollen and carbonized macrofloral remains. Because of the shallowness of cultural deposits at Divostin and the consequent aeration of the soil, in addition to the mechanical disturbances, pollen grains of less resistant species were destroyed. They caution that their results must therefore be interpreted with caution.

Analysis of pollen from a profile at Divostin showed a high frequency (mean value 86%) of nonarboreal pollen, particularly plants regarded today as weeds. Probably a local village vegetation is being sampled. Arboreal pollen shows a dominance of Quercus, Ulmus, and Tilia in the surrounding area.

Faunal Analysis. Animal bones from the sites were identified and studied by Dr. S. Bökönyi, National Museum, Budapest. His results are summarized in Figure 7. The 5-fold increase in number of bones from Starčevo to Vinča reflects the fact that the site was far richer in Vinča than in Starčevo materials. From Figure 8, we see that the percentages reflect marked differences

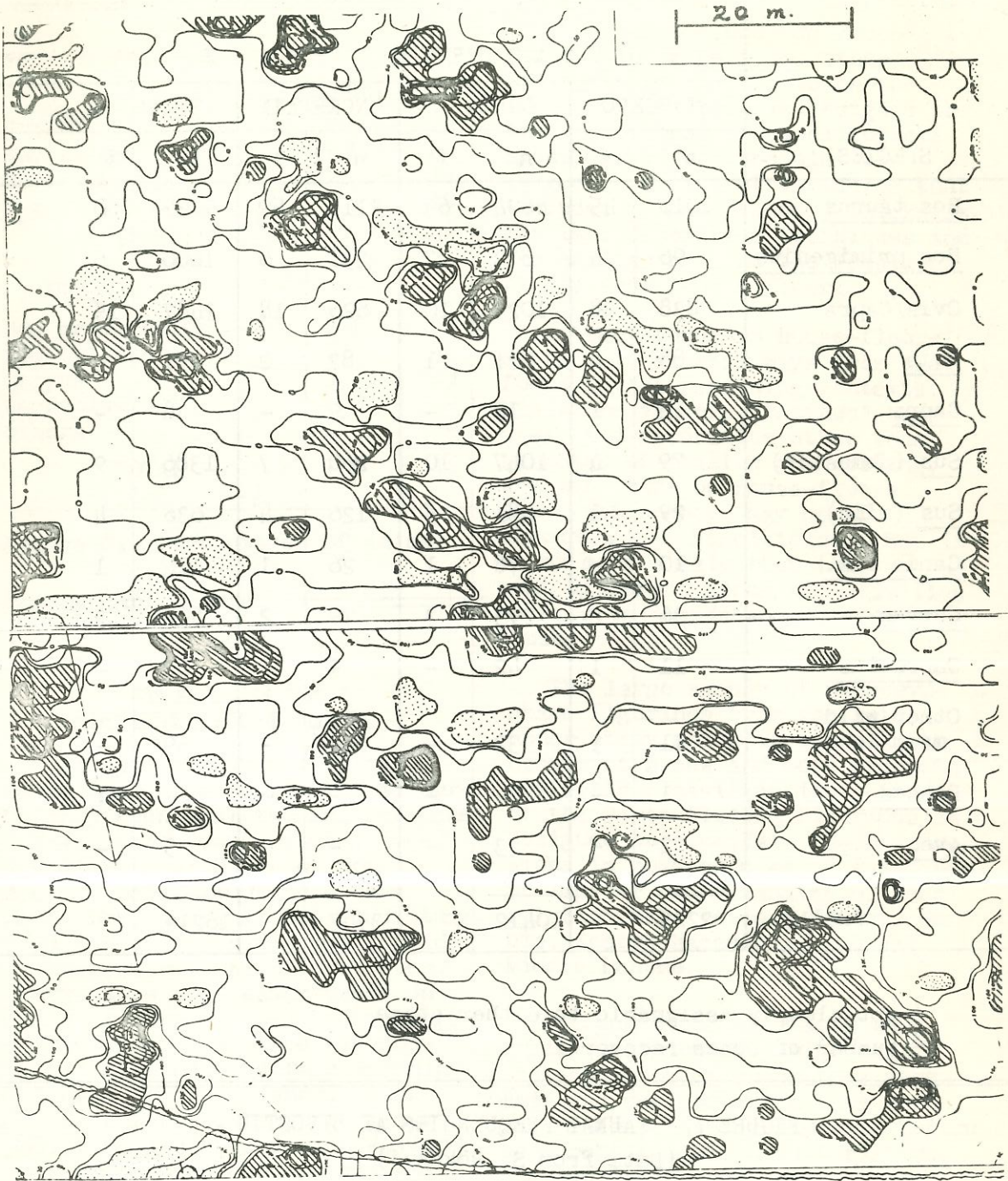


Figure 6. Map of strong magnetic anomalies (hachured areas) at Grivac.

SPECIES	CULTURAL PHASE							
	STARČEVO		VINČA		UNCERTAIN <sup>1</sup>		TOTAL	
	n <sup>2</sup>	%	n	%	n	%	n	%
<u>Bos taurus</u>	1010	45	6604	63	2118	59	9732	60
<u>Bos primigenius</u>	96	4	673	7	231	6	1000	6
<u>Ovis/Capra</u>	838	38	1023	10	626	18	2487	15
<u>Ovis</u>	88	4	121	1	82	2	291	2
<u>Capra</u>	14	1	15	-	9	-	38	-
<u>Sus (domestic)</u>	79	4	1047	10	260	7	1386	9
<u>Sus (wild)</u>	29	1	481	5	126	4	636	4
<u>Canis fam.</u>	10	-	78	1	26	1	114	1
<u>Cervus</u>	36	2	293	3	79	2	408	3
<u>Capreolus</u>	11	1	42	-	9	-	62	-
Other wild mammals	11	1	32	-	16	-	59	-
<u>Pisces</u>	1	-	-	-	-	-	-	1
<u>Aves</u>	2	-	3	-	-	-	5	-
TOTALS	2225		10412		3582		16219	

<sup>1</sup> Not clearly assignable to either phase

<sup>2</sup> Number of bones recovered

FIGURE 7. FAUNAL FREQUENCIES AT DIVOSTIN  
(Data from S. Bökönyi)

in the contributions of individual species to the faunal spectra for the two periods.

The major change is in domestic cattle, which increase from 45% in Starčevo to 63% in Vinča units-- an increase made at the expense of sheep/goats, which decline markedly

from Starčevo to Vinča. The increase gains in significance when one considers that a cow provides about 10 times as much meat as a sheep or goat. The percentage of domestic pig bones also increases. On a smaller scale, the figures also suggest that hunting may have increased in importance in Vinča times.

	STARČEVO	VINČA
DOMESTIC		
<u>Bos taurus</u>	45 %	63 %
<u>Ovis/Capra</u>	43	11
<u>Sus (domestic)</u>	4	10
TOTAL	92 %	87 %
WILD		
<u>Bos primigenius</u>	4 %	7 %
<u>Sus (wild)</u>	1	5
<u>Cervus</u>	2	3
<u>Capreolus</u>	1	-
others	1	-
TOTAL	9 %	15 %

Figure 8. Percentages of animal bones.

#### ANALYSIS OF ARCHEOLOGICAL DATA

Because few archeological assemblages from South-Central Europe have been analyzed and published in full, and because it was hoped to deal with problems of more general social importance than chronology, a highly detailed study of excavated materials was considered necessary. As a first step, observations and measurements on artifacts were encoded and punched on IBM cards. The same was done for all classes of data concerning each unit of provenience. Such methods enforce consistency, make tabulation and description easier and more precise, and permit the testing of hypotheses about the ways in which different classes of data "behave" with respect to one another. The purposes of such efforts, in the long run, are to enable the archeologist to explain the meaning of his data, rather than merely to make educated guesses about it.

Study of the 400-odd reconstructable vessels and other artifacts found in situ on the fired house-floors is designed to test functional and sociological hypotheses. The vessels were scored on a list of variables that include: shape, temper, thickness, handles, decorative techniques and designs, as well as the location of the vessel on a floor.

Pottery found on house-floors differs in several ways from that found in the remaining contexts. Miniature vessels, "horned" handles, and decoration other than by means of shallow channelling, are very rare on house-floors. These differences may be of chronological significance, but it seems more likely that they represent different kinds of activities carried on inside and outside of houses.

The large sample of Starčevo-phase figurines from the sites under study makes it possible to construct a new and more accurate stylistic classification. Study of the Vinča-Pločnik figurines is designed to elucidate their functions in household activities, and to improve understanding of areal relationships between Central Serbia, Kosovo-Macedonia, and the Middle Danube.

Chipped stone artifacts were studied particularly with regard to techniques by which they were made and uses to which they were put, rather than purely with regard to morphological characteristics. The neolithic industries in the area appear "amorphous," in that stone tools generally lack deliberate shaping into formal categories by secondary retouch. That is particularly true of the Starčevo industry.

The function of tools was inferred from microscopic examination of use-scars and other traces of wear, such as glossy abrasion. The functions inferred include cutting, whittling, and scraping of soft materials such as meat and skins and hard materials such as wood, bone, and antler. The function of the "microborers" could not be satisfactorily demonstrated, even after study with a scanning electron microscope. Very few blades used as knives had been modified in shape in any way, and the blades with the most modification were the ones used to scrape hard materials and those shaped into microborers. Many blades show signs of use for cutting grasses, by the presence of an area of high gloss across the edge. Few of these were retouched, but many had been used for some other purpose before being finally put to use as "sickle blades."

A large group of blades and flakes were made of the same Miocene tuff that was widely used for axe/adzes in the Vinča phase. Their edges were thickened by retouch, and they were then used for some heavy scraping purpose.

The ground-stone axe/adzes and gouges eluded easy classification. Many were reduced from their original shape and size by resharpening; many had broken but the portion including the cutting edge was re-used. A total of 27 measurements and observations were taken on each specimen, and statistical techniques are being employed to determine groupings and to fit the broken specimens into the groups.

The account given here has touched on only the most basic aspects of the work of the Divostin project. Many lines of analysis are still in progress; a number of them, however, have already led to advances in archeological technique and method. On the basis of a pioneering extensive excavation at one site and the testing of a few others, it will be too much to expect to be able to reconstruct the life-ways of early farmers in Central Serbia, much less to offer convincing explanations of the observed changes through space and time, but it can at least be said that the work of the project has moved in the direction of these aims.

SMITHSONIAN INSTITUTION FOREIGN CURRENCY  
GRANT NO. 0592, "EARLY FOOD-PRODUCING  
CULTURES IN YUGOSLAVIA"

SECOND INTERIM PROGRESS REPORT  
MARCH 1970

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## SECOND INTERIM PROGRESS REPORT

### I. EXCAVATIONS AT DIVOSTIN

Extensive excavations were conducted at Divostin from 9 Sept. to 5 Dec. 1968, and from 19 May 1969 to 4 July 1969.\* In the six months of fieldwork, a total of 1,925 square meters of the site were opened.

Divostin was the site of a farming village in both the Starčevo (early neolithic) and Vinča-Pločnik (late neolithic) phases of the Serbian prehistoric sequence. One C<sup>14</sup> date has been obtained for the early phase: 5020 B.C.  $\pm$  70 (H. Quitta, pers. comm.). Dates for the late phase are expected to fall in the range 3600-3200 B. C.

As is typical of many sites in the area, the only undisturbed remnants of the early occupation were the pits that had been dug into the subsoil by the Starčevo people. Several partially preserved Starčevo house floors, however, indicate that continued excavation would likely yield a more intact habitation layer. The stratification of the two occupation phases was mainly "horizontal," meaning that there was a tendency for different areas of the site to be occupied in each phase. There was little superpositioning of deposits one above the other.

Excavations yielded 7 complete house floors of the late phase, at least 11 partially preserved house floors of both phases, and a minimum of 48 pits of various dimensions pertaining to both phases.

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\*A fuller account of the first field season is contained in the First Interim Report, dated 31 March 1969.

Over 1,300 bags of cultural materials were filled during the excavations, which also yielded the largest known sample of Starčevo figurines.

The massive house floors with in situ household artifacts were the most prominent feature preserved in the late occupation, and are certainly the most important class of data from the whole project so far. Although details on wall and roof construction are lacking, remarkable full information on floors could be obtained. The technique of floor construction was as follows. A subfloor consisting of wooden beams was first laid in place on the ground, then a layer of damp clayey earth mixed with straw was packed on, pounded flat, and smoothed. The same earth and straw was also used to construct low partitions, enclosures for hearths, and basin-shaped objects that held milling stones for grinding grain.

A large number of houses at Divostin and other sites were found burned. Whether this resulted from natural or human agency cannot at present be determined. The wooden subfloor provided both fuel and draft, with the result that the structures of earth and straw were baked into a low-grade ceramic. Pottery vessels--originally gray to black in color--were also refired to an orange terracotta-like color, and the organic materials, including of course all wood and bone, were completely destroyed. The fires seem to have marked the termination of prehistoric occupation of the site, for no unfired materials were found in association with a house floor, and the unfired materials that came from the soil layer between the floors and the surface

can be explained as the result of scattering of artifacts through plowing.

During the course of the first field season, scientists and technicians from the Yugoslav Geomagnetic Institute tested the parent soil and cultural features of the site for magnetic susceptibility, collected samples from hearths for archeomagnetic dating, and surveyed a portion of the site with a proton magnetometer. Figure 1, based on the magnetometer survey, shows isolines of equal magnetic intensity, and one observes pronounced magnetic anomalies at a number of points. Finding that the fired floor material was pronounced magnetic, in the second season we tested by excavation the hypothesis that the mapped anomalies were houses. The results of excavation are superimposed in red on figure 1: each anomaly tested was found to correspond to a house floor. Thus the magnetometer method seems ideal for obtaining the over-all pattern of a site and produces a plan that can then be used as a guide to excavation. Obviously, only sites with such rarely-encountered features as burned floors and baked clay hearths are suitable for such a method. The continuation of the magnetometer prospecting that is being conducted by Miss Elizabeth Ralph will be discussed below.

## II. TEST EXCAVATIONS AT RELATED LOCAL SITES

Testing of nearby neolithic sites was conducted in the 1969 season. Objectives, in addition to the search for an early neolithic site with well-preserved occupation horizon, included the obtaining of reliable samples of cultural materials

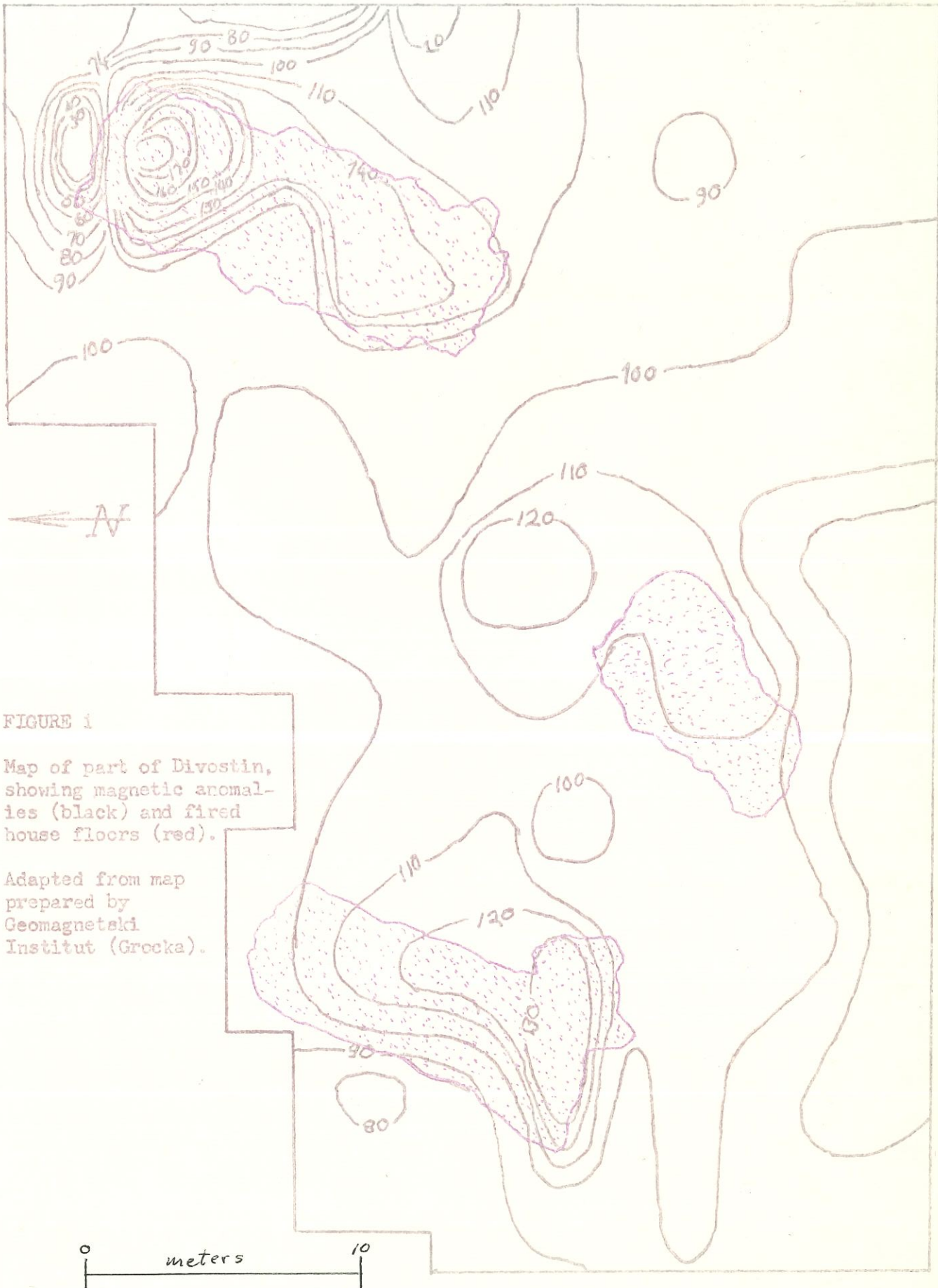


FIGURE 1

Map of part of Divostin, showing magnetic anomalies (black) and fired house floors (red).

Adapted from map prepared by Geomagnetiski Institut (Grocka).

0 meters 10

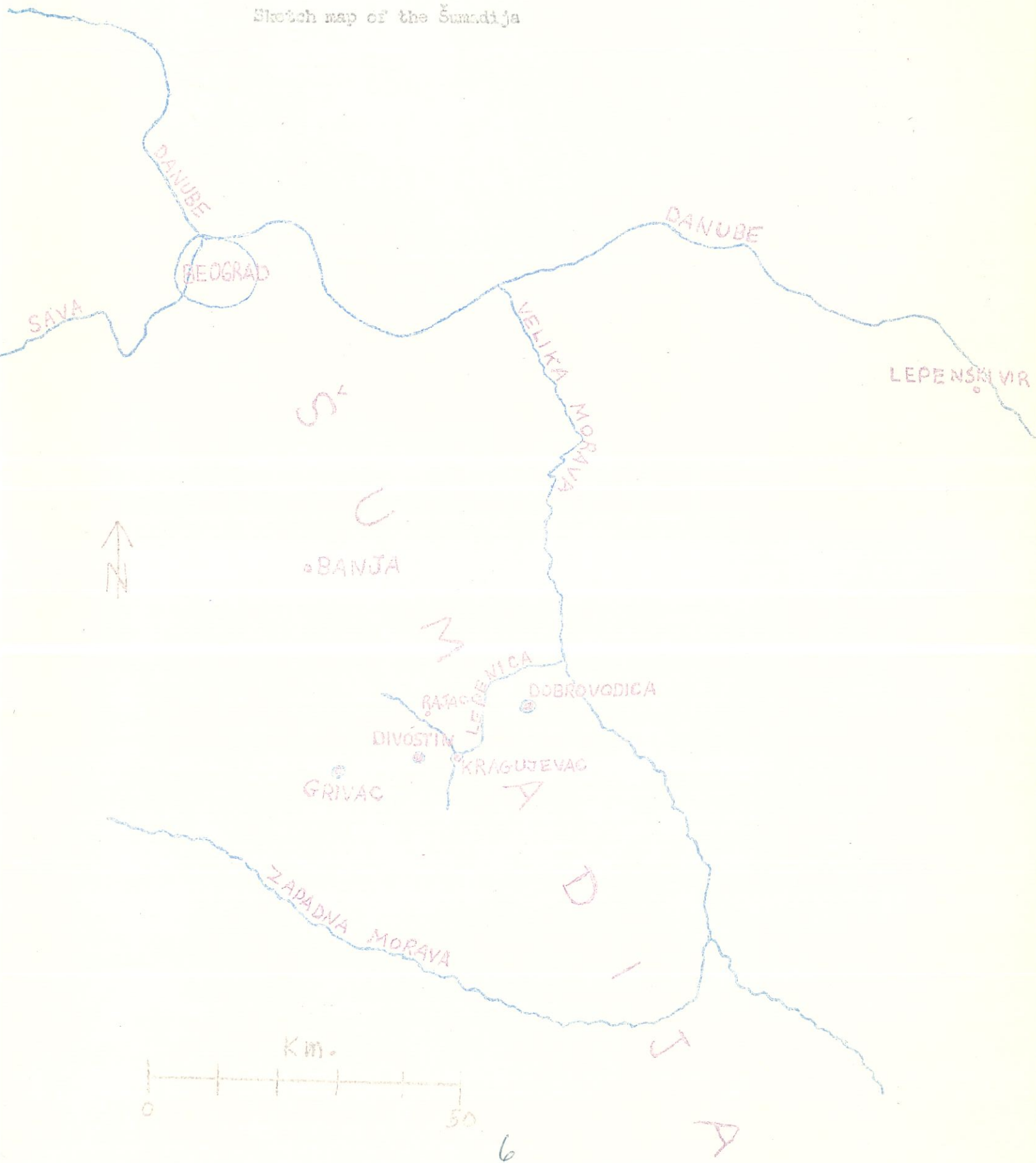
for comparison with Divostin, comparative ecological study using geological, faunal, and floral evidence, and the obtaining of charcoal samples for  $C^{14}$  dating. Excavations were conducted at four sites, as shown in Figure 2. Banja and Dobrovodica were pure early period (Starčevo) sites, Rajac pure Vinča, while Grivac, first dug a number of years ago by Dr. Branko Gavela, has both Starčevo and Vinča occupations with good stratigraphic separation, and well-preserved Vinča houses.

The single 4 x 4 meter unit begun at Dobrovodica turned out to have been poorly placed as far as throwing light on the cultural deposit was concerned. Materials from the unit and gathered on the surface suggest close similarities with Divostin Starčevo. Work at the site was suspended as the result of difficulties with the landowner.

Twelve test units totalling 350 square meters were dug at Banja in the area of the site where most artifacts were found scattered on the surface. Most of the units produced very sparse materials and no features or signs of an occupation horizon, but three units contained typical large Starčevo pits. The upper layers of one pit contained large pieces of baked earth with straw, typical house-construction material, suggesting that permanent houses had existed but left no traces except where the construction materials sank below the surface level as the fill of pits settled. The pottery and flint artifacts closely resemble both Divostin and Dobrovodica. At all three sites, coarse wares dominate the ceramics, while painted wares are absent. Thus these sites differ stylistically from many "classical" Starčevo sites.

FIGURE 2

Sketch map of the Šumadija



The differences in preservation between Starčevo and Vinča occupations, forming a consistent pattern seen at many sites, suggest that some event such as widespread sheet erosion took place in Serbia at the end of the Starčevo phase, seriously damaging most sites. For this reason, the search for an intact Starčevo habitation layer is of considerable importance.

At Grivac, excavations were conducted by Dr. Gavela in a previously unexplored part of that very extensive site, revealing a Starčevo occupation stylistically somewhat different than the three just mentioned, but no better preserved. There were also two Vinča building horizons, both of them stylistically earlier than the one at Divostin. Portions of two burned houses pertaining to the latest Vinča building phase were excavated (cf. Fig. 3). They are of great interest for the light they throw on building construction. As at Divostin, a timber subfloor had been first laid in place. At Grivac, it was made of logs about 10 cm. (4 in.) in diameter rather than of quartered timbers as at Divostin. A thick layer of wet earth with straw had then been packed on. We found that when the fired floor material was removed during excavations, perfect positive impressions of the logs were visible in the underlying soil, and negative impressions were preserved on the underside of the baked floor material.

Because the cultural layers are more deeply buried at Grivac than at Divostin and there is stratigraphic separation between the different layers, Grivac represents a better archeological situation than Divostin. In addition, while at Divostin much of the site cannot be excavated because it lies under the roads

and buildings of the modern village, at Grivac most of the site is not so obstructed. Results of the magnetometer survey of Grivac are presented below.

At Rajac, surface collection and magnetometer survey were carried out, but time and funds did not permit the digging of even a single test unit. That is to be regretted, for the site appears to represent a single component of a phase of Vinča that is stylistically intermediate between Grivac and Divostin, and burned houses are known to exist.

Future work conducted at all of these sites would be of importance, for each presents potentials for the solution of particular problems, and comparison of them would greatly advance the study of neolithic cultural adaptations.

### III. FIELD EXPLORATIONS AND SURVEYS

#### A. ARCHEOLOGICAL SURVEY.

The plans for intensive site reconnaissance in the Lepenica Valley and Divostin area in the spring of 1969 did not eventuate for a number of reasons, including Yugoslav army maneuvers. That work is planned for the coming summer, for which a research team including botanists, soil scientists, and a geomorphologist is being organized. Cave exploration will also then be conducted in an effort to locate a sequence from paleolithic into neolithic. The transition period is completely undocumented at the moment in central Serbia.

#### B. GEOLOGICAL SURVEY.

A brief geomorphological and mineralogical survey of the Divostin area was conducted in June 1969 by Dr. Jelena Marković-

Marjanović, the only Holocene specialist in Serbia. Her findings, including identifications of the materials used in the flint industries of the sites studied, will be included in the final report of the project.

### C. MAGNETOMETER PROSPECTING.

Further magnetometer survey with magnificent results was performed in June 1969 by Miss Elizabeth K. Ralph, University Museum, University of Pennsylvania. About 60,000 square meters, or about 1/3 of the site, were surveyed at Divostin, locating an additional 12 anomalies, which are assumed to be houses on the basis of those tested. Because of the proximity of modern structures and the impossibility of working in maturing wheat fields, some of the more interesting parts of the site could unfortunately not be surveyed.

At Grivac, the results were spectacular, as seen in Figure 3. (North is to the top of the map.) The map shows the two units excavated in 1969 by Dr. Gavela in the upper right corner, with the portions of the two houses that were encountered drawn in green. The area below the units, about 113 by 140 meters, was surveyed in the course of a day and a half, with magnetometer readings being taken every 2 meters, by Miss Ralph. The readings were plotted on graph paper, and isolines drawn showing the lines of equal magnetic intensity. In Figure 3, only isolines representing 50 gammas are shown. The resulting amoeba-like forms in rows can be assumed to be burned house floors, on the basis of the two floors (shown in the upper right) that were actually excavated. The picture one obtains is that of a large village with "planned" appearance, a situation hardly

equalled in any other neolithic situation, and even more impressive when one considers that the portion surveyed with the magnetometer represents less than 1/5 of the entire site, judging from the distribution of artifacts on the surface.

It would clearly be highly desirable to finish the magnetometer mapping of Grivac and generate a sampling design for testing anomalies by excavation. The outcome would be information of an order of magnitude far greater than that possible by any other means, save possibly the economically unfeasible excavation of the entire site.

At Rajac, magnetometer survey indicates a patterning of houses similar to Grivac but on a much smaller scale. At Banja, the instrument could not be used in the area chosen for excavation because of the proximity of modern structures. Other areas of the site yielded negative results. At Dobrovodica, similarly, no anomalies were detected.

It may be concluded that, with the particular instruments and techniques used, burned house floors and hearths can easily be detected, but other features such as pits and trenches elude detection. Further work is obviously needed: to complete the survey at Divostin and Grivac, and to try other techniques for the location of pits on Starčevo-period sites.

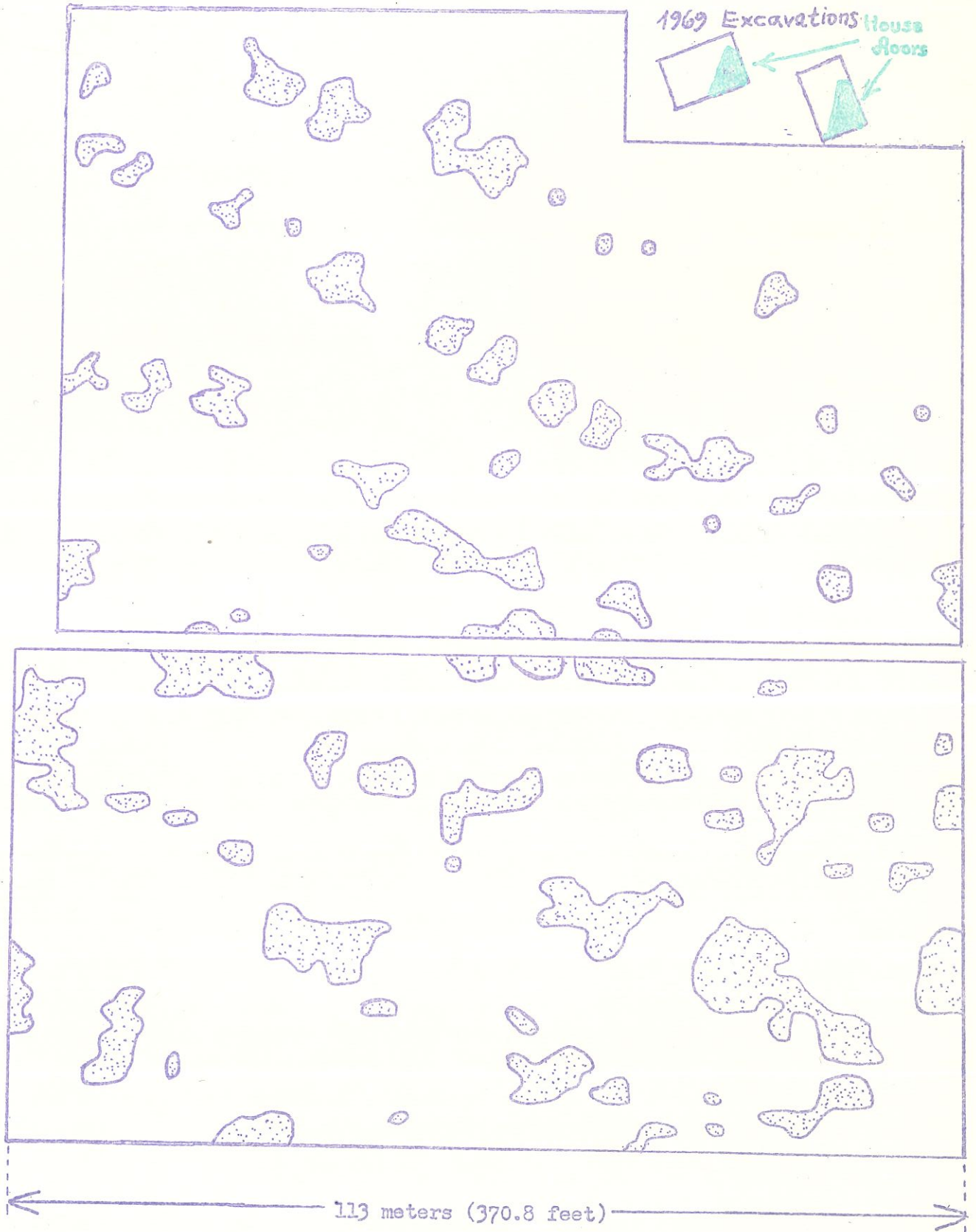
#### IV. SPECIAL ANALYSES

##### A. ARCHEOMAGNETIC DATING.

The hearths from Vinča houses at Divostin are admirably suited for archeomagnetic dating, a procedure based on the principle that, when cooled from a high temperature, materials

FIGURE 3

Map of magnetic anomalies at Grivac (adapted from map prepared by E. Ralph. Only anomalies greater than 50 gammas shown)



containing iron compounds regain the magnetism lost during the heating, but with magnetic orientation parallel to the flux lines of the earth's magnetic field. Since intensity, inclination, and declination of the magnetic field at any point on the earth vary through time, differences in these parameters between the present and the sample being studied are a function of time.

In 1968, samples were submitted to the Yugoslav Geomagnetic Institute for measurement. No results have yet been received, in part because of failures of the equipment. In the 1969 season, the principle investigator invited Dr. Evžen Neustupný and Mrs. Anna Kalenská of Prague (from the Archeological Institute and Geophysical Institute respectively) to collect samples to be measured in Dr. Buchá's laboratory in Prague. Forty samples were collected from Divostin, Grivac, and Banja. Samples were also taken at other prehistoric sites in Serbia. Results are expected shortly from Dr. Buchá's laboratory.

#### B. RADIOCARBON AND THERMOLUMINESCENCE DATING.

Eighteen charcoal samples from Divostin, Grivac, and Banja have been sent to the Berlin radiocarbon laboratory. So far one date has been received: an estimate of 5020  $\pm$  <sup>70</sup> B. C. for a large Starčevo pit at Divostin (Object 15). Portions of two of the above samples have also been submitted to the British Museum laboratory.

Ten sherd samples have been sent to Dr. Aitken's laboratory at Oxford for thermoluminescence dating.

#### C. FAUNAL AND FLORAL ANALYSIS.

The more than 33,000 pieces of food-animal bone were identified and studied in July 1969 by Dr. Sandor Bökönyi of

Budapest. Twenty-eight soil and pollen samples are at present being studied by Drs. Hans-Jürgen Beug and Eberhard Grüger of the Botanical Institute, Göttingen. Further information on utilized plants is expected from included-plant remains in fired house-floor material and grain impressions on pottery, in a study now being conducted by the principle investigator and students in the Archeological Laboratory, University of Pittsburgh.

The assembled data will be integrated with all other categories of data--level, provenience, associated artifacts, etc.--to permit study of localized differences in activities on the site, and differences between phases as a whole.

#### D. HUMAN SKELETAL REMAINS.

The two skeletons from the site were studied by Dr. Janos Nemeskeri, Budapest. His report will be included in the final monograph.

#### V. ANALYSIS OF ARTIFACTS AND OBJECTS

The principle investigator brought back to the U. S. the total recovered artifact samples of worked flint, copper (or copper ore), and obsidian; selected samples of pottery, hearth, and house-floor material; copies of all items of technical documentation, including 142 field drawings, 580 black-and-white photographs, 240 color slides, the consolidated field daily record, artifact counts, etc. During the autumn and winter 1969-70, data have been punched onto IBM cards and a series of catalogs prepared under different headings, permitting one to search according to provenience coordinates, field catalog number, inventory number, or object number. All data will be encoded

and punched on cards to permit easy manipulation and statistical analysis.

Study of the flint artifacts in Pittsburgh is nearing completion. Attribute analysis is being used, and considerable time devoted to microwear and function analysis, a study in which the principle investigator and his students are working in close cooperation with Dr. Ruth Tringham, who had been invited to examine the flint in the field and instructed the principle investigator in the techniques involved.

Copper artifacts are to be analyzed by the neutron activation technique at the Argonne National Laboratories. Obsidian will be similarly analyzed in Dr. Gordus' laboratory at the University of Michigan.

The field plans are being studied by the principle investigator, who has devised a technique for displaying the successive stages of excavation analytically in a single figure. The monograph will mark the first use of this technique in archeology.

The pottery, stored in a building in Kragujevac near the museum that has been specially set up for this purpose, is at present being studied by Dimitrije Madas, who was one of the Diploma Archeologists in the field both seasons. His study of the pottery along traditional lines will be complemented by the attribute analysis to be performed by Stephen Kaufman, a student archeologist the second season, whose study will also serve as his doctoral dissertation.

## VI. WORK CONDUCTED IN EUROPE 1969-70

The principle investigator travelled to Yugoslavia in the winter recess. He spent several days in London, where he

participated in a symposium at the Royal Society on "Archaeology and the Natural Sciences," worked with Dr. Tringham on the microwear analysis of flint tools, and visited the British Museum and Institute of Archaeology. He and Dr. Tringham will jointly prepare the report on the flint tool assemblages from the sites under study, and will also study the Lepenski Vir flint assemblage for a separate publication.

In Prague, he consulted with Dr. Neustupný and Mrs. Kalenská at Dr. Buchá's laboratory, where useful discussions were held about archeomagnetic dating methods.

In Belgrade, consultations were held with Dr. Srejović with regard to plans for completing the analysis of data and preparing and publishing the monograph. The principle investigator also consulted with the director and senior scientists of the Geomagnetic Institute regarding their possible participation in further magnetometer prospecting and their completing the work on the samples that were submitted to them over a year ago. He copied manuscripts and out-of-print materials at the Yugoslavian branch of the Library of Congress, and wishes to place on record his appreciation that the facilities there were placed at his disposal by the director, Mr. Bowman. He was also able to meet scientists from the Institute for Soil Science, and made arrangements for them to join the palinologists, Drs. Beug and Grüger, in the field next summer. They will secure pollen profiles from the Divostin area to permit temporal placement of the pollen samples taken from the Divostin site, by fitting them into a pollen chronology.

In Kragujevac, the work now in progress by Srejović, Bogdanović, Madas, and Jerinić in the new facility at the museum was reviewed by the principle investigator and extensively discussed, and plans were finalized for distributing the work load of data description and analysis for the monograph.

## VII. PUBLICATIONS AND PAPERS READ

The principle investigator has presented or will present papers on aspects of the work, as follows:

Midwest Archeological Conference, October 1969  
 American Anthropological Association, Annual Meetings,  
 Nov. 1969  
 Department of Anthropology, New York University, Lecture  
 Series, Nov. 1969  
 Department of Anthropology, University of Pittsburgh,  
 Colloquium, Jan. 1970  
 Center for Russian and East European Studies, Univ.  
 of Pittsburgh, Feb. 1970  
 Department of Anthropology, Illinois University,  
 Colloquium, Feb., 1970  
 Society for American Archaeology, Annual Meetings,  
 May 1970

A paper on the magnetometer prospecting co-authored with Miss Elizabeth Ralph is in press for Expedition, and a more technical version is under preparation for Science. A third co-authored with Prof. Mužijević of the University of Belgrade, is being prepared for Nature. A brief report on the first season's excavations by Bogdanović has appeared in Arheološki Pregled. A short resume of the work as a whole is being prepared by the principle investigator for Illustrated London News.

The monograph, envisioned as a comprehensive descriptive report on the project, will tentatively be titled "Divostin and the Neolithic Occupations of the Central Šumadija." It will be

jointly edited by McPherron and Srejović, and will contain contributions as follows:

- Introduction (McPherron and Srejović)
- Site Description and Stratification (Bogdanović, Srejović, and McPherron)
- Magnetometer Prospecting (Ralph, Stefanović, and Muzijević)
- Architecture and other Objects (Bogdanović and McPherron)
- Artifact Descriptions:
  - Pottery Description (Madas)
  - Statistical Analysis of Pottery (Kaufman)
  - Chipped Stone Industry: Classification and Analysis of Microwear and Function (McPherron, Tringham, and End)
  - Terracotta Figurines (Srejović)
  - Ground-stone axes and other Tools (McPherron)
  - Bone and Antler Tool Industry (McPherron)
  - Other Small Finds (copper ornaments, unidentified terracotta objects, miscellaneous ornaments: McPherron)
  - Milling Stones: typology and distributional analysis (Galdikas)
  - Woven Fabrics, as reconstructed from fabric impressions on pottery (Rasson)
- Environmental Studies:
  - Geography and Geomorphology (Marković-Marjanović)
  - Food-Animal Bones (Bökönyi)
  - Paleobotany (Beug and Grüger)
  - Human Skeletal Remains (Nemeskeri)
- Dating:
  - Archeological dating (Srejović)
  - Radiocarbon Estimates (Quitta)
  - Archeomagnetic dating (Buchá and Neustupný)
  - Thermoluminescence (Aitken)
- Archeological and cultural synthesis (McPherron and Srejović)
- Comparisons with other Sites (Srejović)
- Conclusions (McPherron and Srejović)
- Annotated Bibliography and Index (Jerinić)

Publication is planned as offset, quarto format, dual column with English and Serbocroatian text side by side. Text and line drawings will be set in Yugoslavia, but plates, printing, and binding will probably be done in the West. The publishers will formally be the National Museum in Kragujevac and the University of Pittsburgh Press. The coauthors are determined

to have the volume ready for distribution by the time of the  
8th International Congress of Pre- and Proto-Historic Sciences,  
to be held in Belgrade in September 1971.

# C U R R I C U L U M V I T A E

ALAN McPHERRON

Born 3 April 1929, Chicago.  
Married (Stase P. McPherron); one child.

## Academic Training:

B.A., University of Chicago, 1957. Major in  
history, minor in modern languages.  
M.A., University of Michigan, 1962, anthropology.  
Ph. D., University of Michigan, 1966.

## Other Training:

Summer Institute of Linguistics, 1954  
Research Assistant, Museum of Anthropology, 1959-60  
Teaching Fellow, Department of Anthropology, 1960-61  
Slavic Languages Trainee, University of Indiana, 1967

## Languages:

German: fluent  
Serbocroatian: fluent  
French: read easily, speak fairly well  
Spanish: read and speak fairly well

## Military:

U.S. Army, 1955-56. Stationed in Germany.

## Academic Distinctions:

University Scholar, Univ. of Michigan, 1961-62  
Dissertation Research Fund grantee, School of  
Graduate Studies, 1962-63

## Archeological Experience:

Twenhafel Site excavations crew member (Joseph  
Caldwell, Director), 1958  
Teotihuacán Valley Project member (René Millon,  
Director), 1959  
Juntunen Site excavations field director, 1960-61  
Pittsburgh area brief excavations director, 1965-66  
Cuicatlán Valley, N. Oaxaca (brief survey conducted  
in 1965 with Robert Hunt, in attempt to locate  
early contact period occupations to study in conjunc-  
tion with early Spanish documents)  
Yugoslavia, survey of museum collections, sites under  
excavation; consultation with Yugoslav archeologists  
Divostin Project ("Early Food-Producing Cultures in  
Yugoslavia") (see below, "current research")

## Grant Funds Received:

Teotihuacán Valley Project, travel and per diem, 1959  
Cuicatlán Valley, work financed by Grant-in-Aid from  
Wenner-Gren Foundation

Yugoslav Survey, financed by grants from the International Dimension Fund and the Faculty Development Fund, University of Pittsburgh

Divostin Project, financed by grants from Foreign Currency Program, Office of International Activities, Smithsonian Institution (8-0592), NSF (GS-2218), and International Studies Program (Univ. of Pittsburgh)

Memberships in Professional Organizations:

American Anthropological Association (fellow)  
Society for American Archaeology  
Archeological Society of Yugoslavia  
International Union of Pre- and Proto- Historic Sciences  
Amer. Assn. for the Advancement of Science  
Sigma Xi

Academic History:

1963-present: Instructor and Assistant Professor,  
Department of Anthropology, Univ. of Pittsburgh

Course offerings: Introductory Anthropology, Human Evolution, Cultural Adaptations, Primitive Technology, Archeological Theory & Methods, Old World Prehistory, New World Prehistory, European Prehistory

Committee work: Departmental Committee on Curriculum, Departmental Committee on Graduate Studies (chairman), Univ. Committee on Honors Program, Univ. Committee on E. European Studies

Associate Editor, "Ethnology"

Professional Interests:

Topics: Cultural ecology, quantitative methods, dating methods, origins of farming, prehistoric social organization

Areas: Europe (especially Balkans), Great Lakes, Mesoamerica (especially Valley of Mexico)

Publications:

1963 Late Woodland Ceramics in the Straits of Mackinac. Pap. Mich. Acad. Sci., Arts, and Let. XLVIII: 567-76.  
1965 Ionic Removal of Corrosion from Copper. Mich. Arch. 11: 53-56.  
1967a Pottery Style Clustering, Marital Residence, and Cultural Adaptations at an Algonquian/Iroquoian Border. In Tooker, E., ed., Proc. 1965 Iroquois Conference. N.Y. State Museum, Albany

- 1967b The Juntunen Site and the Late Woodland  
Prehistory of the Upper Great Lakes Area. Univ.  
Mich. Mus. Anth., Anth. Pap. 30.  
1967c (review of) Wright, J.V., The Ontario Iroquois  
Tradition. Mich. Arch., 13: 152-3.

In Preparation:

(review of) Ehrich and Pleslova, Homulka: an Eneolithic  
site in Bohemia. (Amer. Anthropologist)

Current Research:

From June 1968 through August 1969 I was in Yugoslavia. Six months of excavation were conducted at the large Starčevo and Vinča site "Divostin," near Kragujevac, in central Serbia. Working with the nominal codirectorship of Dr Dragoslav Srejović of the University of Belgrade, I had a staff consisting of up to 6 diploma-archeologists, 4 student architect-draftsmen, 6 Yugoslav archeology students and an equal number from the U.S., surveyor, photographer, bookkeeper, and up to 70 local workmen. Nearly 2000 square meters were opened at Divostin, yielding remains of 9 houses of the Vinča phase, 4 large pits of the Starčevo phase, and 120 other features, as well as a large sample of artifactual and ecological data. Excavations on a smaller scale were also conducted at 3 other neolithic sites in the vicinity, and several others were surveyed.

We were most fortunate in obtaining the services of the following specialists:

- Elisabeth Ralph (Univ. Museum, U. Pa.): Cesium magnetometer survey of Divostin and other sites, June, 1969.  
Evžen Neústupný (Arch. Inst., Prague): Archeomagnetic dating of hearths and other fired material, June, 1969.  
Hans-Jürgen Beug, Tübingen: Botanical analysis.  
Sandor Bökönyi (Nat. Mus., Budapest): Faunal analysis.  
Hans QUITTA (Berlin): Radiocarbon Dating.  
Ruth Tringham (London): Microscopic study of stone tool utilisation.  
Geomagnetic Institute, Grocka, Yugoslavia: Proton magnetometer study at Divostin, October, 1968.

I am at present working on documentation, stone artifacts, and computer processing of data at Univ. of Pittsburgh, with a half-time teaching load provided by the NSF grant. I expect to return to Yugoslavia in December, to consult with Dr. Srejović and see what work has been done by the diploma-archeologists in my absence. I will return there again at the end of the winter term, to finish analysis of artifacts and make preparations for publication. I have Dinar funds for a sizable monograph, which we expect to publish in dual columns, English and Serbocroatian. We plan to have the finished monograph ready for distribution by the time of the 1971 international congress in Belgrade.

In addition to the monograph, I am preparing an article for Science, together with Elisabeth Ralph, on our magnetometer work,

a short article with Dr. Srejović for Illustrated London News, and will prepare a number of other publications based on the quantitative analysis, most of which will probably appear after finishing the monograph.

The work conducted so far was highly successful and a very good beginning, but there are many more problems to be worked on in the Balkans. I expect to continue work in Yugoslavia, and next time will take trained students, for whom I could arrange dissertation projects. I also hope to add other American archeologists to the staff, since I found that it was nearly impossible for one person from the U.S. side to represent the interests of American scholarship in such a project. I expect to work with Dr. Ruth Tringham in an analysis of Lepenski Vir chipped stone material, and with Dr. Neustupný on an absolute chronology of the Vinča site, using a combination of techniques.

Professional work of my wife:

Stase P. McPherron conducted a study of the changing educational system in its relations with traditional and modernizing society, in Kragujevac. Her work will be incorporated in her dissertation, to be submitted to the University of Michigan.