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**Short Report  
On Scientific and Technical Research Conducted  
By the Belarusian Antarctic seasonal Expedition of 2008-2009  
As a Part of the Russian Antarctic Expedition No. 54**

**1. General Information**

**1.1. Short History**

From 1956 to 1991 more than 150 Belarusian specialists participated in the exploration and development of the Antarctic, being members of the Soviet Antarctic expeditions. Over that period they did a lot of research activities, observations and wrote a lot of studies.

**Year 2006**

The president of the Republic of Belarus, Alexander Lukashenko, signed a Law of the Republic of Belarus “On Joining of the Republic of Belarus in the Antarctic Treaty.”

The National Academy of Sciences of the Republic of Belarus worked out a state goal-oriented program “Monitoring of Polar Regions of the Earth and Support of the Activity of Arctic and Antarctic Expeditions for the years 2007-2010 and for the period till 2015” (from here on referred to as the State Program).

The Council of Ministers of the Republic of Belarus approved the State Program.

**Year 2007**

For practical realization of goals of the State Program, an executive body of control, the Republican Centre of Polar Investigations, was formed under the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus.

## **Year 2008**

The president of the Republic of Belarus, Alexander Lukashenko, signed a Decree “On Joining of the Republic of Belarus in the Protocol on Environmental Protection to the Antarctic Treaty.”

### **1.2. Tasks and Goals of the State Program**

The main goal of the State Program is to expand scientific research and monitoring of the state of the natural environment in the polar regions of the Earth. These aim at receiving by the Republic of Belarus of a status of a participant with equal rights in the world process of research and utilization of high-latitude regions of the planet, at securing its long-term interests of presence and practical activity in the polar regions of the planet and effective fulfillment of international obligations through the integrated usage of available intellectual, financial and material resources of the interested parties.

The State Program has the following main goals and tasks:

- to send scientific expeditions;
- to build the first Belarusian Antarctic infrastructure (stations, camps) equipped with modern technological equipment and instruments for scientific observation of domestic and foreign producers;
- to create a system of monitoring of the natural environment state in the polar regions of the Earth;
- to receive up-to-date practical experience in supporting the activity of long-term polar expeditions;
- to test and experimentally operate in extreme conditions new technical equipment, devices, specimen products and materials of domestic producers;
- to implement experimentally progressive energy-efficient technologies and to use renewable energy sources;
- to settle the matters of ecological nature and carry on activities on protection of nature;
- to develop and strengthen international cooperation in the sphere of exploration of polar regions of the Earth;
- to train competent personnel for Belarusian Antarctic expeditions.

### **1.3. The Second Seasonal Antarctic Expedition of the Republic of Belarus As a Part of the Russian Antarctic Expedition No. 54**

In order to fulfill the tasks of the State Program, from November 2008 to May 2009 the Department of Hydrometeorology and the Republican Centre of Polar Investigations under the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus organized the second Belarusian seasonal Antarctic expedition (from here on referred to as BAE) consisting of six experts included into the Russian Antarctic expedition no. 54.

The expedition was carried out for the purposes of extending the sphere of scientific interests of the Republic of Belarus in the region of Eastern Antarctica (Thala Hills, Enderby Land) where the Belarusian Antarctic station is planned to be deployed. It is also conducted for the purposes of supporting the research results obtained by the Belarusian specialists in the period of their participation in the work of the seasonal Russian Antarctic expedition no. 52 of 2006-2007 and during the fulfillment of tasks of the State Program by the participants of the first BAE of 2007-2008, which was a part of the Russian Antarctic expedition no. 53 (from here on referred to as RAE).

The main goal of the second BAE was to carry out a set of organizational, logistic, engineering-technical and research activities for laying down the foundations for launching the system of monitoring of the state of natural environment and for organizing long-term national polar research in

the area where the Belarusian Antarctic expedition in Eastern Antarctica is based (Thala Hills, Enderby Land), while performing the tasks of the State Program as a part of the RAE no. 54.

All the activities scheduled in the framework of the second BAE were carried out in the period from December 15, 2008, to March 12, 2009, on the prior agreement with the Russian party and with the logistic support of the RAE.

The Second BAE of 2008-2009 had the following tasks to fulfill:

- to ensure the activities for launching the system of complex monitoring of the natural environment of the Antarctic;
- to obtain new data on the state of nature in the Antarctic;
- to equip the Belarusian Antarctic expedition with instruments and devices;
- to provide the Belarusian Antarctic expedition with technological equipment of life support, transport vehicles and communication facilities;
- to perform the international obligations of the Republic of Belarus in accordance with the requirements of the Protocol on Environmental Protection to the Antarctic Treaty;
- to conduct mutually agreed with the Russian party engineering and logistic activities.

#### **A. The Belarusian Antarctic Expedition's Field Camp Vechernyaya Mountain**

The field camp of the seasonal BAE was situated in immediate proximity to the Russian Antarctic expedition's field base Vechernyaya Mountain, which is situated in 11-14 kilometers to the east from the Russian Antarctic expedition's seasonal station Molodyozhnaya. Geographical coordinates of the Belarusian seasonal Antarctic expedition's field camp are S67°39.550', E46°09.496', h = 79.7m.

Vital activity of the BAE's field camp is provided by two diesel generators delivered from the Republic of Belarus and rigged with engines of the German producer DEUTZ with the power of 20 and 60 kW. The said generators are assembled into specially rigged, environmentally safe containers and equipped with remote automatic system of start and control of the engine performance parameters. Besides, the participants of the BAE have at their disposal two emergency generator sets of the German company GEKO with the power of 7 and 6 kW, which are situated in the container-type installations at 50 – 150 meters' distance from the BAE's main camp.

For information transfer and contacts with the outer world, the participants of the BAE have at their disposal two satellite communication sets of the INMARSAT system and two satellite phones IRIDIUM.

For performing seasonal work and over-land transport operations, the participants of the BAE have at their disposal three snowmobiles of the Finnish producer LYNX, a track-type quadrocycle of the Canadian producer QUTLANDER "APACHE" and a snowmarshmobile of the Russian producer "BOBR."

The BAE's field camp has a reliable life support system and is well-equipped for conducting seasonal work and research by expeditionary personnel of up to 10 people.

#### **B. Vessels**

The Republican Centre of Polar Investigations under the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus does not have its own vessels, nor does it use rented sea crafts.

The delivery of cargo and personnel of the Belarusian seasonal expedition to the place where seasonal work in Eastern Antarctica is conducted was carried out aboard the "Akademik Fyodorov" research vessel, with the logistic support of the Russian Antarctic expedition.

### **C. Aviation**

The Republican Centre of Polar Investigations under the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus does not dispose of any aircrafts.

### **D. Rocket Research**

The Republic of Belarus does not utilize research rockets in Antarctica.

### **E. Military Personnel and Equipment**

The Republic of Belarus does not use military personnel or equipment in Antarctica.

## **2. Non-Governmental Expeditions**

### **A. Touristic Trips**

There were no touristic trips performed in the area of the Belarusian expedition location.

### **B. Flights**

On February 2 and 8, 2009, from the snow-ice takeoff and landing strip of the Russian Antarctic expedition situated near the Vechernyaya mountain there were performed intra-continental transit flights on the aircrafts BASLER.

For the delivery of personnel and cargo of the Belarusian expedition from the “Akademik Fyodorov” research vessel to the field camp Vechernyaya Mountain and for the evacuation from Antarctica two Russian helicopters MI-8 were used.

### **C. Sea Craft Operations**

In the summer season of 2008-2009, the Belarusian party did not conduct any marine oceanographic operations with the usage of sea crafts.

### **D. Over-Land Operations**

In the summer season of 2008-2009, over-land research trips were not conducted.

## **3. The Admission Information**

### **3.1. Visiting Protected Areas**

In the area where the Belarusian expedition operates, on the Thala Hills of the Enderby Land in Eastern Antarctica, there are no specially protected and specially controlled areas, therefore a special permission for scientific activity in this area is not needed.

### **3.2. Environmental Impact Assessment**

Preliminary assessment of Belarusian expedition activity demonstrated that it would have less than insignificant impact on the environment of the Antarctic.

The activity of the Belarusian seasonal expedition of 2008-2009 was conducted in accordance with the requirements of the Protocol on Environmental Protection in the Antarctic to the Antarctic Treaty (from here on referred to as the Protocol) and did not have a negative influence on the environment of the Antarctic.

In the process of its work, the Belarusian expedition of 2008-2009 laid down the foundations of ecological monitoring of natural environment of the Antarctic.

When planning the future research, the Republic of Belarus will refrain from any activity that can have a negative impact upon the natural environment of the Antarctic.

### **3.3. Conservation of Antarctic Flora and Fauna**

In the process of scientific sampling of flora and fauna there were no instances of elimination or harmful interference.

### **3.4. Introduction of Non-Aboriginal Species of Animals and Plants**

No non-aboriginal species of animals and plants were delivered to the area where the Belarusian expedition worked.

Foodstuffs of animal and vegetable origin were stored under strict control in specially equipped storehouses, while their remains were disposed of in accordance with the Annex III to the Protocol and with the Supplement C to this Annex.

### **3.5. Waste Disposal and Waste Management**

In order to comply with the requirements of the Protocol by the Belarusian party, the participants of the BAE conducted a complex of environmental measures, as a result of which for removal from the territory of the Antarctic were prepared 3.5 tons of waste from the BAE activity, including:

- plastic waste;
- fuel tanks;
- other solid non-combustible waste.

All the waste prepared for removal from the area covered by the Antarctic Treaty is stowed at the field camp of the Belarusian expedition in specially equipped places, which excludes a possibility of its dispersion in the environment.

Taking into consideration small quantity of personnel of the Belarusian seasonal expedition of 2008-2009, domestic liquid waste and wastewater were dumped into the sea in the places that provided the conditions for their primary dilution and quick dispersion.

Besides, for collection and disposal of fecal waste the participants of the Belarusian expedition used composting toilets filled with special neutralizing liquids, which complies with the provisions of Annex IV to the Protocol.

The aim of these environmental measures for the said period was to minimize the impact of the BAE activities on the environment of the Antarctic and to avoid additional costly nature-conservative measures for removal of environmental damage.

### **3.6. National Legislation**

There has started the development of the Concept for the second stage (2011-2015) of the State goal-oriented program “Monitoring of Polar Regions of the Earth and Support of the Activity of Arctic and Antarctic Expeditions for the years 2007-2010 and for the period till 2015.”

## **4. Other Information**

### **4.1. Report on Inspections**

In the period of summer Antarctic season of 2008-2009 there were no inspections in the area of the Belarusian Antarctic expedition activity.

### **4.2. Notification of Actions Undertaken in Emergency Cases**

In the period of summer Antarctic season of 2008-2009, there were no emergency situations in the area where the BAE worked.

### **4.3. Expeditionary Logistics**

Delivery and evacuation of the BAE personnel, expeditionary cargo, equipment and fuel to/from the seasonal work site was carried out with the logistic support of the Russian Antarctic expedition aboard the “Akademik Fyodorov” research vessel.

Vital activity of the BAE and fulfillment of research schedule was ensured by the seasonal staff of six persons, including three scientists in the priority areas of research.

## **5. Production of Scientific Observations in the Period of Summer Antarctic Season of 2008-2009**

### **5.1. Carrying Out Instrumental Hydrometeorological Observations and Measurements, As Well As Environmental Observations**

A standard program of meteorological observations was carried out in the period of the second BAE activity, from December 22, 2008, to March 12, 2009. It had a goal to create a basis for launching the modern system of hydrometeorological observations and measurements, as well as to continue seasonal meteorological observations of the previous expeditions for accumulating the sequences of data.

Parallel to the production of the standard program of manual instrumental hydrometeorological observations from January 2 to March 12, 2009, there was conducted an hourly automatic registration of main meteorological characteristics with the usage of the automatic meteorological station M-49M produced by Russia.

Meteorological observations were carried out in accordance with the requirements of the “Manual on the System of Global Observations,” volume II, 1995, and of the Annex No. 3 of the World Meteorological Organization MO-No.544, November 2007.

Besides this, during the period of production of expeditionary work there was ensured a production of daily observations on the particularly dangerous meteorological phenomena and on the change of ice conditions at the coastal zone of the Alasheyev Bay in the Cosmonauts Sea.

Among the most important results of the fulfilled tasks of the State Program on launching measurement instruments and conducting meteorological observations are the following:

- data obtained from meteorological observations were sent through the channels of satellite communication to the address of the Department of Hydrometeorology and Hydrometeorological Centre for further automated processing with the aim to form a database and to assess the parameters of space-time changeability of thermal conditions of the Antarctic atmosphere in its surface air layer over the Enderby Land during the period of seasonal observations;
- data of urgent meteorological observations obtained by the Belarusian specialists were transmitted through the channels of satellite communication to the Novolazarevskaya and Progress Russian Antarctic stations for safeguarding the flights in accordance with the international project DROMLAN;
- launching of measurement instruments and conduct of meteorological observations in the area where the Belarusian Antarctic expedition is situated, namely on the Thala Hills of the Enderby Land in Antarctica, laid down the foundations for opening (registration) in the nearest years of the post of meteorological observations with the aim to integrate meteorological research conducted by the Belarusian party in this region of Antarctica into international research programs on Antarctica and atmosphere monitoring network of the WMO.

## **5.2. Monitoring of the Ozone Layer**

The measurement of the total ozone content (from here on referred to as TOC) in the BAE's field camp "Vechernyaya Mountain" was conducted over the entire period of the expedition with a modernized ozonometer M-124.

Besides this, in January 2009 the BAE's field camp Vechernyaya Mountain launched a system of measuring the concentration of surface ozone. The device worked in automatic mode in the period from 04.01.09 to 10.03.09 without any changes in its location.

The Belarusian specialists conducted a complex of investigations of the ozonosphere parameters and as a result continued the TOC observational series and identified anomalous behavior of diurnal variation of the surface ozone concentration.

The results of the measurement of the total ozone content and the concentration of surface ozone in the atmosphere, conducted in the period of seasonal expeditions of BAE of 2006-2009 on the Thala Hills of the Enderby Land in Eastern Antarctica, were presented in the National Report of the Republic of Belarus at the Meeting of the Ozone Research Managers of the Parties to the Vienna Convention for the Protection of the Ozone Layer in 2007 in Geneva. They were also reported at the All-Russian conference "Development of a System of Monitoring of Atmosphere Content" (Moscow, 2007) and at the XII and XIII International Conferences for Young Scholars in Zvenigorod (Russia). The results of observations materials carried out by the Belarusian specialists during the seasonal BAEs of 2006-2009 underlie the article "Investigations of the Ozone Layer in the Oasis Molodyozhnyj Area in Seasonal Expeditions of RAE of 2006-2007," which is prepared for publication in the journal "Problems of the Arctic and the Antarctic."

## **5.3. Over-Land Monitoring of the State of Atmospheric Aerosol**

In the period of 2007-2008, the Belarusian specialists worked out the methods and equipment for remote monitoring of the atmospheric aerosol and clouds. In the course of expeditionary investigations of 2008-2009 the built equipment was successfully tested in field observations in Antarctica, where in the period from 25.12.2008 to 11.03.2009 the Belarusian specialists conducted regular measurements of characteristics of suspended in atmosphere particles.

On the ground of the observation results, new scientific data on the dynamics of aerosol layer change in the coastal zone of Antarctica were obtained. Radiometric station under the name Vechernaya Hill (68 U, 45 V) was connected to the global radiometric network AERONET, which thereby solved a complex technical and procedural task. The creation of a new radiometric station in Antarctica is a considerable step in the development of atmospheric investigations in Antarctica. The website of the AERONET/PHOTONS network shows the information obtained from 25.12.2008 to the first decade of March 2009.

The results of the expedition participants' work on the creation of a new radiometric station were highly appreciated by the Coordinator of the International Radiometric Network PHOTONS, professor P. Goloub.

The results of the first set of measurements were reported at the international conference "36<sup>th</sup> Annual European Meeting on Atmospheric Studies by optical Methods," which took place on August 17-22, 2009, in Kiev (Ukraine).

#### **5.4. Conducting a Complex of Biological and Hydrobiological Investigations**

During the field season of 2008-2009 the Belarusian specialists conducted complex biological investigations of maritime, limnetic and terrestrial flora and fauna, including the following:

- conducted reconnaissance exploration of the places of localization of terrestrial, maritime and limnetic resources, and the total length of research routes makes 225 kilometers, about 125 of which are recorded;
- traced the dynamics of main representatives of the pinnipeds, birds, whales, both in static state and in the course of vessel movement; thus 111 observations on the cetaceans were made and 1095 marine sections were explored;
- carried out the total collection of zooplankton, as well as sampling of glacial alga in the stations chosen for monitoring;
- conducted a preliminary estimate of a possibility of creation of a specially protected area or a place of particular scientific interest in the vicinity of the "Vechernyaya Mountain" field camp on the territory of the Gnezdovoy Cape;
- collected herbarium material, including more than 1280 samples of lichen (Lychenophyta), moss (Bryophyta) and terrestrial algae;
- assessed the ecological situation and laid down the foundations for ecological monitoring of the environment in the area of location of the Belarusian expedition.

Preliminary results of complex biological investigations in 2007-2009 of maritime, limnetic and terrestrial flora and fauna in the area of the BAE activity in Antarctica, including those with the usage of the light diving outfit, were reported by the representatives of the National Academy of Sciences of Belarus at international scientific conferences on the problems of the Antarctic – International Antarctic Conference IAC2008, Kiev, Ukraine, and International Antarctic Conference IAC 2009, Kharkiv, Ukraine, which were held in the framework of events of the International Polar Year in Ukraine.

Up to the present, the materials on phytoplankton, zooplankton, zoobenthos, the pinnipeds, birds, fish, moss and lichen collected by the Belarusian researchers in the process of conducting a complex of biological and hydrobiological investigations in 2008-2009 in the Antarctic have been partially processed and are under continuous examination by the specialists. In particular, they have demonstrated that the taxonomic composition of phytoplankton from Antarctic lakes is close to the one in thermal springs from other regions of the planet.

In most important areas of biological research in Antarctica the Belarusian specialists established scientific contacts with the scientists from Russia, Poland, Ukraine and some other countries – parties of the Antarctic Treaty.

## **5.5. Geophysical Research**

In the course of its expeditionary activities from December 2008 to March 2009, the second BAE continued complex geophysical and geochemical investigations of lithosphere, which were started by the Belarusian specialists in 2007-2008 in the area of BAE location, on the Thala Hills of the Enderby Land in Antarctica.

Geologic-surveying routes in the area of the Belarusian Antarctic expedition activity were made along the sites of complex geological structure and for the purposes of conducting geochemical investigations.

As a result of reconnaissance geologic-surveying trips along these routes in the area of the BAE location were discovered geological, geodynamic and geochemical inhomogeneities. The data obtained from field observations were used to build a tectono-physical section, which characterizes underlying structure of lithosphere in the region.

Geophysical investigations in the area of the Belarusian Antarctic expedition activity were performed in two modes: stationary observatory observations and profile magnetometric measurements. Detailed gravimetric observations were carried out along four routes.

In February 2009 the representatives of the National Academy of Sciences of Belarus took part in the XLII International Tectonic Meeting in Moscow (Russia) and presented a report on “First Geologo-Geophysical Results in the Area of the Belarusian Antarctic Expedition Location on Thala Hills of the Enderby Land in Eastern Antarctica.”

At present, the data collected by the Belarusian researchers in the process of conducting geophysical investigations in 2008-2009 in the Antarctic is partially processed and continues to be examined by the specialists.

## **5.6. Additional Research Activities and International Cooperation**

**A.** In the period from 22.12.08 to 10.03.09, route physiographic trips by vehicles and on foot were carried out with the aim of reconnaissance investigation of mountain terraces and platforms in the area of the BAE base camp Vechernyaya Mountain. The data from this investigation provided the grounds for assessment of representativeness of explored platforms and mountain terraces in terms of their practical usage for deployment, in perspective, of technological and residential facilities of the Belarusian Antarctic base (station) and for installation of observation devices there.

**B.** In the course of field operations of the second BAE two units of complex engineering power-producing devices were tested and successfully operated in extreme climatogeographic conditions, as prescribed in the framework of the State Program tasks on implementation of progressive energy-efficient technologies and usage of renewable energy sources:

- uninterruptible power supply, line MODULYS, model Mob-EB 1212 (from here on referred to as UPS);
- solar panel (light-electric-generator) with bypass accumulator.

Experimental operation of the said energy devices led to positive practical results and confirmed high effectiveness of their usage in the Antarctic conditions in terms of reduction of fuels and lubricants consumption and increased level of personal and environmental safety in the BAE activity area.

C. In the period of work on the Hayes Glacier of the specialists from the Russian Federal State Unitary Enterprise “AEROGEODESY” and the Institute for Planetary Geodesy of the Dresden University of Technology, the BAE participants worked out methods and mechanisms of joint logistic cooperation in realization of international programs and projects, including the following:

- for increasing the efficiency of work performance the participants rendered mutual logistic services, i.e. placing expeditionary outfit and equipment at others’ disposal;
- through a complex of safety and engineering measures the Belarusian specialists ensured additional personal safety of the international group of geodesists.

D. In the framework of the international project DROMLAN on securing aviation flights, the Belarusian specialists took part in a complex of engineering and technical activities for preparation of the landing strip and for reception of transit intra-continental flights in the area of the mountain Vechernyaya, which was a joint project together with the Russian party.

## **6. Expected Results from Realization of Tasks of the State Program in 2008-2009 and Following Years**

The majority of obtained results are innovative, they correspond to the international level of research and make a contribution from the Republic of Belarus to various international programs and projects, first of all to EARLINET-ASOS, GO<sub>3</sub>OS, GAW, IGACO-O<sub>3</sub>/UV, GIANT and some others.

The second BAE thus fully executed the program of predesigned activities, and also conducted a number of additional scientific and practical investigations and engineering-technical and environmental measures, while the assigned goals were achieved and the initial results were obtained.

The latter will be used for the following purposes:

- to provide Belarusian and international organizations with the information on present state of the natural environment in the Antarctic;
- to stir up the activities and demonstrate the interest of the Republic of Belarus in Antarctica in accordance with the goals and tasks defined by the State Program;
- to develop and strengthen international cooperation in the sphere of polar research;
- to efficiently comply with the international obligations of the Republic of Belarus in the framework of the Antarctic Treaty and the Protocol on Environmental Protection to the Antarctic Treaty.

In 2010 and the following years, the Republic of Belarus, in the framework of realization of tasks of the State Program and compliance with the international obligations of the Republic of Belarus under the Antarctic Treaty and with the requirements of the Protocol on Environmental Protection to the Antarctic Treaty, plans to achieve the following main results in the priority areas:

- to send scientific expeditions;
- to expand functional possibilities and improve operational rates of sets of instruments and equipment for remote monitoring of the atmosphere and underlying (snow) surface;
- to obtain new data on the state of the Antarctic natural environment based on results from the distant sounding of the atmosphere and underlying surface done by stationary and cosmic observing systems;
- to work out new methods, data processing algorithms and software support for measuring the parameters of the Antarctic natural environment;
- to obtain new data on resources, minerals and raw materials’ potential, underlying structure and present dynamics of lithosphere of Eastern Antarctica in the area of the Belarusian Antarctic expedition activity;

- to obtain new data on nonuniformity of magnetic and gravitational fields and their relation to cosmic phenomena and demonstrations of endogenous geodynamic processes;
- to obtain new data for identifying the past, current and prognosticating the future changes in the Antarctic natural environment, as well as for estimating the biological reserves of maritime, limnetic and terrestrial ecosystems;
- to work out methods for health preservation and higher working efficiency of the participants of long Antarctic expeditions in the conditions of influence of extreme climato-geophysical natural factors of Antarctica;
- to build, in this region of Antarctica, a national research infrastructure (station or base) equipped with modern scientific, technological and nature-conservative equipment;
- to apply widely the renewable energy sources (wind and solar power) together with accumulative (buffer) sources of nonvolatile power;
- to implement up-to-date nature-conservative technologies for increasing the environmental safety and minimizing the impact of the BAE activities on the Antarctic environment;
- to strengthen cooperation with the Russian Federation and expand international collaboration in the sphere of scientific and logistic activities in the Antarctic;
- to integrate the research into international scientific programs on the research in Antarctica and atmosphere monitoring networks (AERONET, CIS-LiNet, EARLINET, GALION, GAW, IGACO-O<sub>3</sub>/UV, GIANT and other).

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